The FOUNDRY

Volume 51
Number 20

Published
Semimonthly

CLEVELAND, OHIO, OCTOBER 15, 1923

Make Tanning Machine Parts

Peculiar Problems Incident To the Industry Involve the Use of Highly Complicated and Exceedingly Accurate Machinery Made Up for the Greater Part of Iron and Brass Castings

BY PAT DWYER

ALTHOUGH the art or process of preserving the skins of animals and converting them to various uses, including that of clothing, has been practiced from a period antedating any written record, only within comparatively recent years have the various steps in the process been modernized to any extent. Translations of hieroglyphics found in ancient Egypt indicate, according to presumably competent authority, that the industrious inhabitants of the valley of the Nile had cultivated the art of skin preservation to a degree approaching perfection. They not only practiced a method for preserving the hides, but wherever it was considered necessary or expedient they embalmed the entire body. However, this latter phase of their activity was confined to certain illustrious members of their own species and, therefore, really does not bear any relation to the subject of tanning. Earthen bowls were employed to hold the various liquors in which the hides or skins were allowed to soak for extended periods and the process generally, so far as the actual tanning is concerned, was similar to that of the present day tannery.

The Hebrews learned the art during the time of their subjection in Egypt. In all probability they were forced to learn, as they were compelled to do many things that outraged their sensibilities, their physical well-being and their racial customs and beliefs, laid down by their highly orthodox ancestors. The

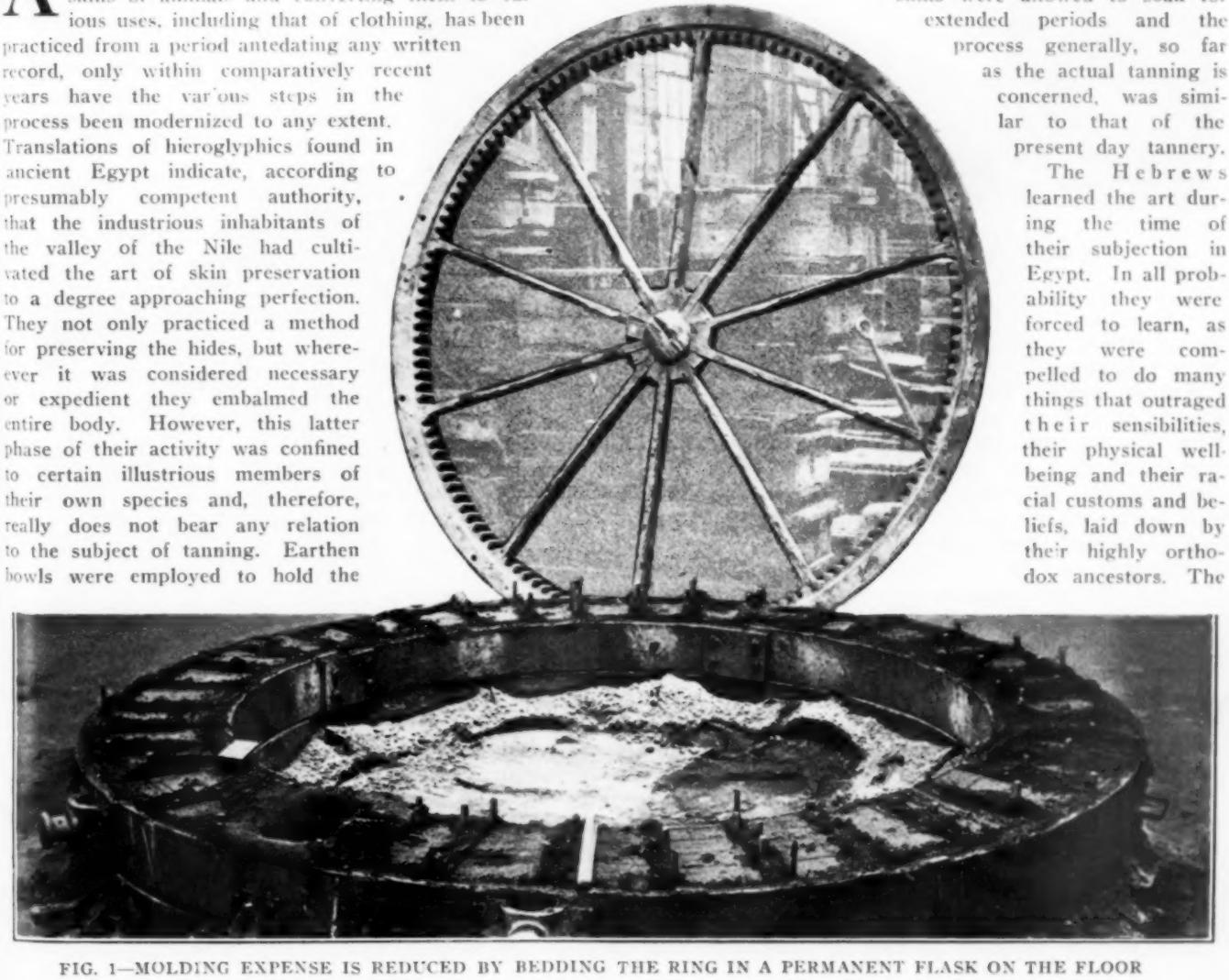


FIG. 1—MOLDING EXPENSE IS REDUCED BY BEDDING THE RING IN A PERMANENT FLASK ON THE FLOOR

tanning business is as honorable as any other, and its importance is attested by the latest United States census which places it sixth on the list of principal industries. It probably held approximately the same position in ancient days; but there is no concealing the fact that a tannery probably is the most malodorous plant ever conceived by man. For that reason, principally, it was despised in Judea and the tanners, while tolerated, were restricted to isolated places beside streams or on the sea shore. For example we read that Simon the Tanner carried on his business in Jaffa on the south side of the harbor where the prevailing winds would not offend the olfactory nerves of those who lived in that famous city before it was taken by the Turks when it became known as Joppa.

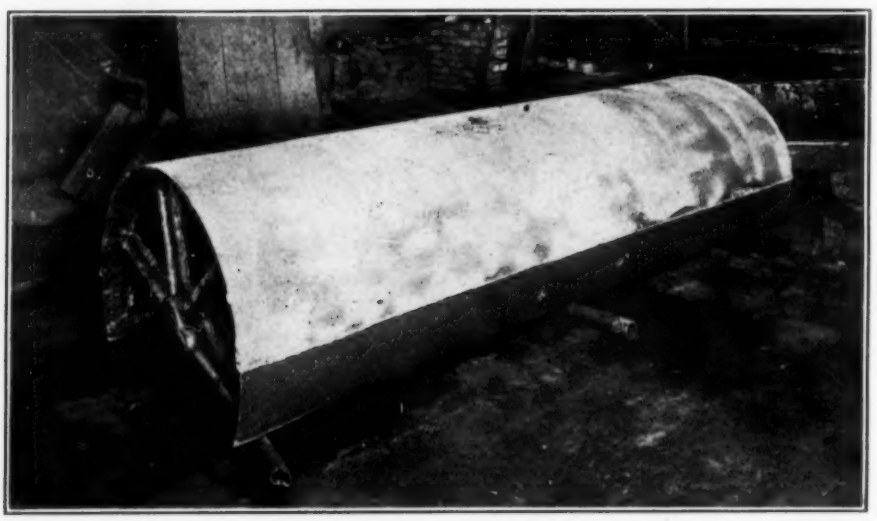


FIG. 2—THE LONG DRUM IS MOLDED AND CAST IN THE POSITION SHOWN—THE MOLD IS FORMED EXCLUSIVELY IN GREEN SAND WITH THE EXCEPTION OF THREE SETS OF ARMS WHICH ARE FORMED IN CORES

English colonists introduced the industry into North America, or at least into that part of it above the 30th parallel of the north latitude. The Spaniards did some work along that line in the territory to the south and the native Indians apparently had a limited knowledge of the subject. The first commercial tanning on record was in Virginia in 1630 and a year later Swampscott, near Lynn, Mass., modestly ventured into the same business. In the succeeding 300 years the tanning business in common with all others has kept pace with the growth and expansion of the country, but New England always has maintained its supremacy, not only in the manufacture of leather and leather products, but also in the production of machinery incidental to the leather industry.

Col. William Edwards in 1794 invented and installed the first mechanical equipment designed exclusively for tannery purposes and since that time practically every one of the 29 major types of machines used all over the world has been developed and first tried out in New England tanneries and factories where leather is manipulated for commercial use. The Turner Tanning Machinery Co., Peabody, Mass., situated in a city where several tanneries are in operation, located near the center of the New England tanning territory and engaged in the development and manufacture of machinery exclusively for the tanning industry, probably is the oldest plant of its kind in this country.

In addition to what may be regarded as standard machines, due to the fact that they have been in successful operation for several years, the company's designing force constantly is aiming toward further improvement or refinement. The plant at Peabody embraces completely equipped wood and metal working shops in which every part that enters into the extensive line of machines is fabricated and assembled, but the scope of the present article embraces only that part of the plant devoted to the manufacture of iron and brass castings. The relative size of the plant may be gaged by those familiar with general manufacturing conditions, by comparison with the foundry. In this instance the activity of the foundry is confined exclusively to the production of castings for the various machines employed in the tanning industry.

The foundry outgrew the old building some years ago and was installed in what formerly was a warehouse, converted and adapted for foundry use as shown in the general view, Fig. 5. The entire building was raised and a 10-foot concrete wall was placed under the existing walls all around. A crane runway designed to support a 5-ton crane was erected on both sides along the full length of the building. On account of the comparatively light load and also because the building mostly was of wood, the runway supporting the rails was made of 12 x 12 timber supported on 10 x 10 posts spaced on 12 foot centers. Suitable 45-degree angle braces bolted on either side of the posts help to keep the timber supporting the rail in alignment.

The brass foundry, the cupola, the core room and oven adjoin the iron foundry all along one side and therefore prevent any light entering from that side. However, that factor does not interfere to any appreciable extent with the lighting as a whole. Ample windows are provided at both ends and along the remaining side and in addition an extensive skylight on both sides of the pitched roof, extending from one end of the building to the other end, furnish all the natural illumination required. This feature is clearly illustrated in Fig. 5.

The cupola spout projects through an opening in the side wall approximately an equal distance from either end of the building. This point also serves as a more or less arbitrary dividing point for the castings destined to be poured with the crane and those poured by hand.

Monorail System

Iron to pour the smaller castings is conveyed in a 1000-pound ladle suspended from a monorail extending from a point immediately above the end of the cupola spout to the end of the foundry. The rail follows the wall of the building on both sides as well as across the end and in addition a branch track extends for a considerable distance over the center of the floor. The installation was made by the Coburn Trolley Track Co., Holyoke, Mass. Iron from the large ladle is transferred to two smaller ladles mounted in pouring frames supplied by the Modern Pouring Device Co., Port Washington, Wis. The smaller ladles, with a capacity of 250 pounds, may be handled by one man while pouring a considerable number of small molds and for that reason it is claimed the method is distinctly superior to that in which the usual hand ladle is employed.

More or less elaborate followboards are supplied for nearly all the patterns. Many of the larger molds are

rammed on a plain jolt machine made by the Tabor Mfg. Co. Philadelphia, while a battery of four power squeeze machines made by the Mumford Molding Machine Co. serve to make the greater number of small molds. It may be of interest to note that machines formerly made by the latter company now are made by the Hanna Engineering Co., Chicago. On account of the fact that most of the large work is made up of small individual orders, the molds are rammed by hand in the manner usually employed in jobbing foundries. Wherever L. T. Lesperance, foundry superintendent considers it feasible to arrange the pattern for machine molding, he has it equipped in the necessary manner. If he cannot arrange it as a machine job he adapts as many machine features to a hand made job as he considers practicable.

For example, consider the methods employed to mold the drum shown in Figs. 2, 5 and 6.

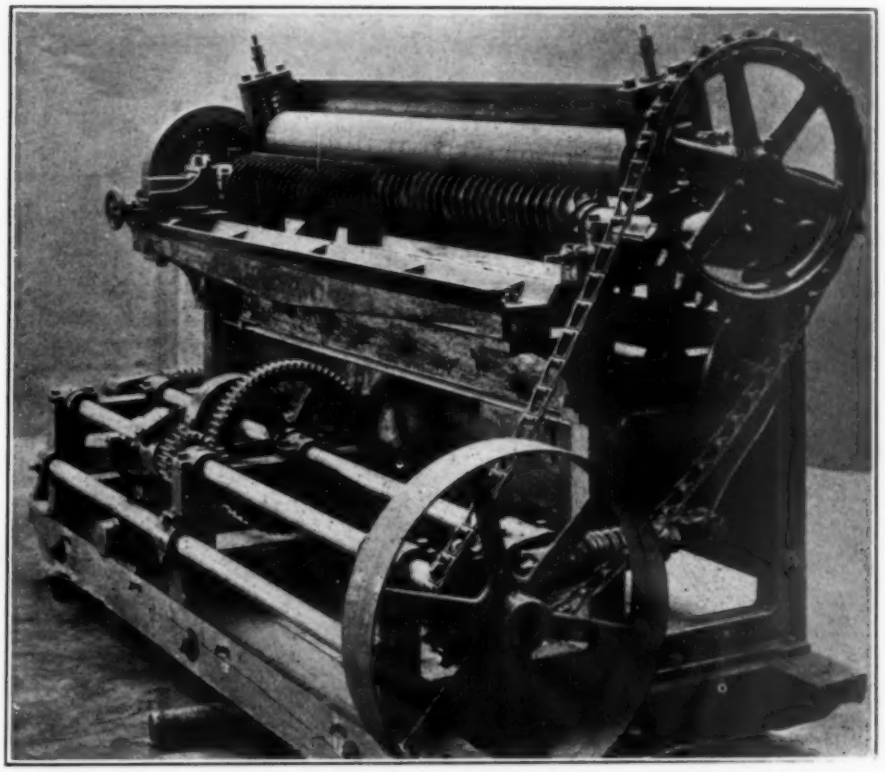


FIG. 4—ONE OF THE MANY MACHINES EMPLOYED IN THE LEATHER INDUSTRY—THE LONG CAST IRON ROLLER EQUIPPED WITH THIN BRASS SPIRALS STRETCHES THE SHEET OF LEATHER AND MAKES IT A UNIFORM THICKNESS

Molding a Drum

These drums are made in various diameters and lengths, but the methods pursued in their manufacture practically is the same in all cases. The casting shown in Fig. 2 is 10 feet long, 40 inches diameter, 5/8-inch metal thickness. It is provided with three sets of arms and weighs approximately 2100 pounds. The casting is made in a green sand mold, convex side up and poured from both ends. On account of having only one crane, the ladle at one end is set up on horses. This is the largest size drum that is made. The others are smaller and are cast successfully from one end.

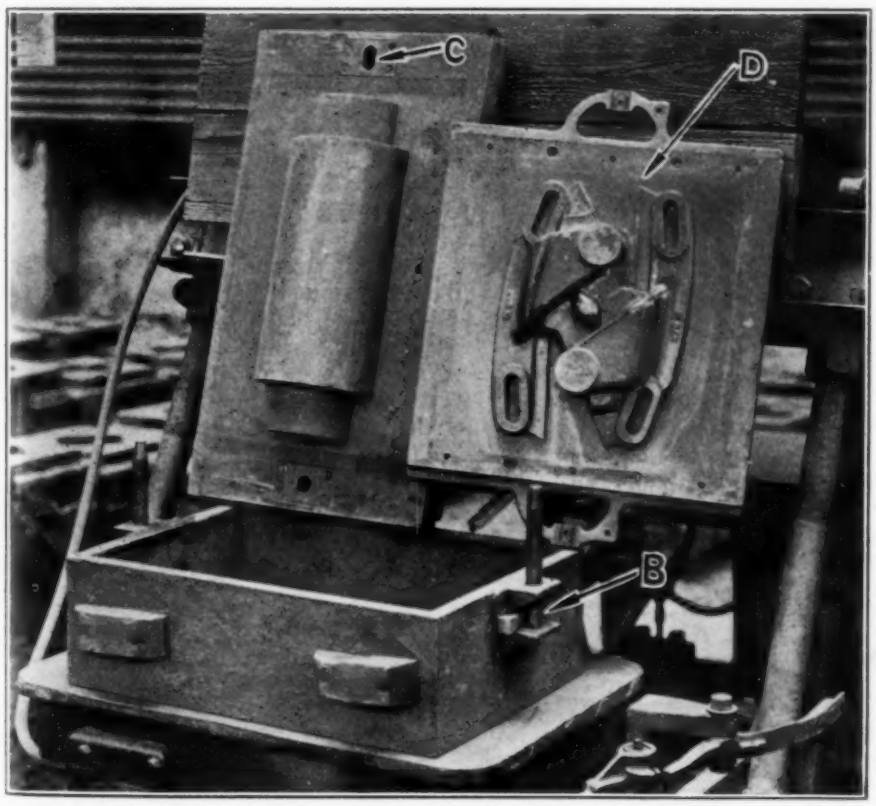


FIG. 3—ILLUSTRATING METHODS OF ATTACHING GUIDE PINS TO FLASKS AND PATTERNS TO VIBRATOR FRAMES

The pattern equipment for making this casting is simple and yet of such a character that it does not warp or become distorted either while in the foundry or in the pattern storage. It consists of a follow board, a number of long narrow staves, slightly curved inside and out, and a corebox. A special flask with the ends cut to conform to the shape of the casting is employed in making the mold. These various features are shown in Fig. 5 and probably a little more in detail in Fig. 6. The curved surface of the drum exceeds a half circle by 8 inches on either side of a diametrical line. This feature is apparent in Fig. 2 where the dark part of the casting represents the part of the rim molded in the drag portion of the mold.

The core to form each complete set of arms is made in two parts and afterward pasted before it is rammed up inside the pattern. Due to the fact that the arms are not disposed symmetrically on either side of a center line, two half coreboxes, one right and the other left are required to make the complete core. One of the advantages of this method of molding the drum is that the cores may be located at any point, thus determining total length of the cast-

ing. In the particular instance shown, the casting was ordered the entire length of the pattern. The corebox is shown at ' Fig. 5.

In practice, the followboard is placed approximately level on the floor. The staves forming the pattern are laid in the form of a lining. The semicircular cores enclosing the arm openings then are dropped into their respective positions. This point is determined by measurement and by suitable marks on the staves. Long bolts inserted through suitable holes extend from one end core to the other and serve to hold them in place. After the drag flask is set on, a third long bolt which passes through suitable holes in the cores, is inserted and screwed up in a manner to prevent the flask ends from straining out of position. In addition to the bolts, wood blocks are jammed between the arm cores and the ends of the drag to prevent the cores from shifting during ramming the interior of the mold with green sand. These various features may be noted in Fig. 6. Usually the entire drag is rammed full of sand before it is rolled over, but the mold shown in the illustration is longer than usual. It is too long for the followboard, hence the space between the core and the end of the flask was left open and was packed full of sand after the drag was rolled over. The illustration shows the mold just before the gap at each end was filled.

Completing the Mold

After the cope is rammed almost as high as the top of the pattern, two gate sticks are placed at each end about 12 inches apart and about 6 inches back from the pattern. The cope then is filled, rammed, lifted off and rolled over. Six or eight shallow gates are tapped into the end of the mold and extended to meet a channel terminating in the two upright runners. Two small pop gates are provided on the highest point of the mold to serve as indicators when the mold is filled with iron. An exceedingly firm joint and careful workmanship throughout is necessary to prevent the mold from straining, to prevent the iron bursting out at the joint, to maintain a uniform thickness of metal and to secure a clean surface when the casting later is machined all over the outside. A coke bed is rammed in the interior to help in conveying the gas and steam away from the convex surface during the pouring process.

The internal ring gear pattern and mold shown in Fig. 1 furnish an interesting example of economical practice. Formerly a wooden flask and bottom board were employed and the drag was rolled over in such a manner that the pattern frequently became distorted and the resulting casting resembled the misshapen pattern. In the present method the comparatively small drag remains permanently on the floor. The joint of the flask serves as a guide to sweep a level bed in the bottom. The pattern is laid on this level bottom and the teeth are packed full of sand. The remaining space in the drag is filled with sand, which then is rammed and scraped off flush with the top of the pattern to form a joint. The cope is rammed in the usual manner and the casting is poured through two runners located on diametrically opposite sides of the mold. Gaps are provided in the inner wall of the drag to accommodate the stiffener arms which hold the ring to a true circle. The depressions left by the arms are stopped off with sand before the mold is closed.

Three features in pattern mounting

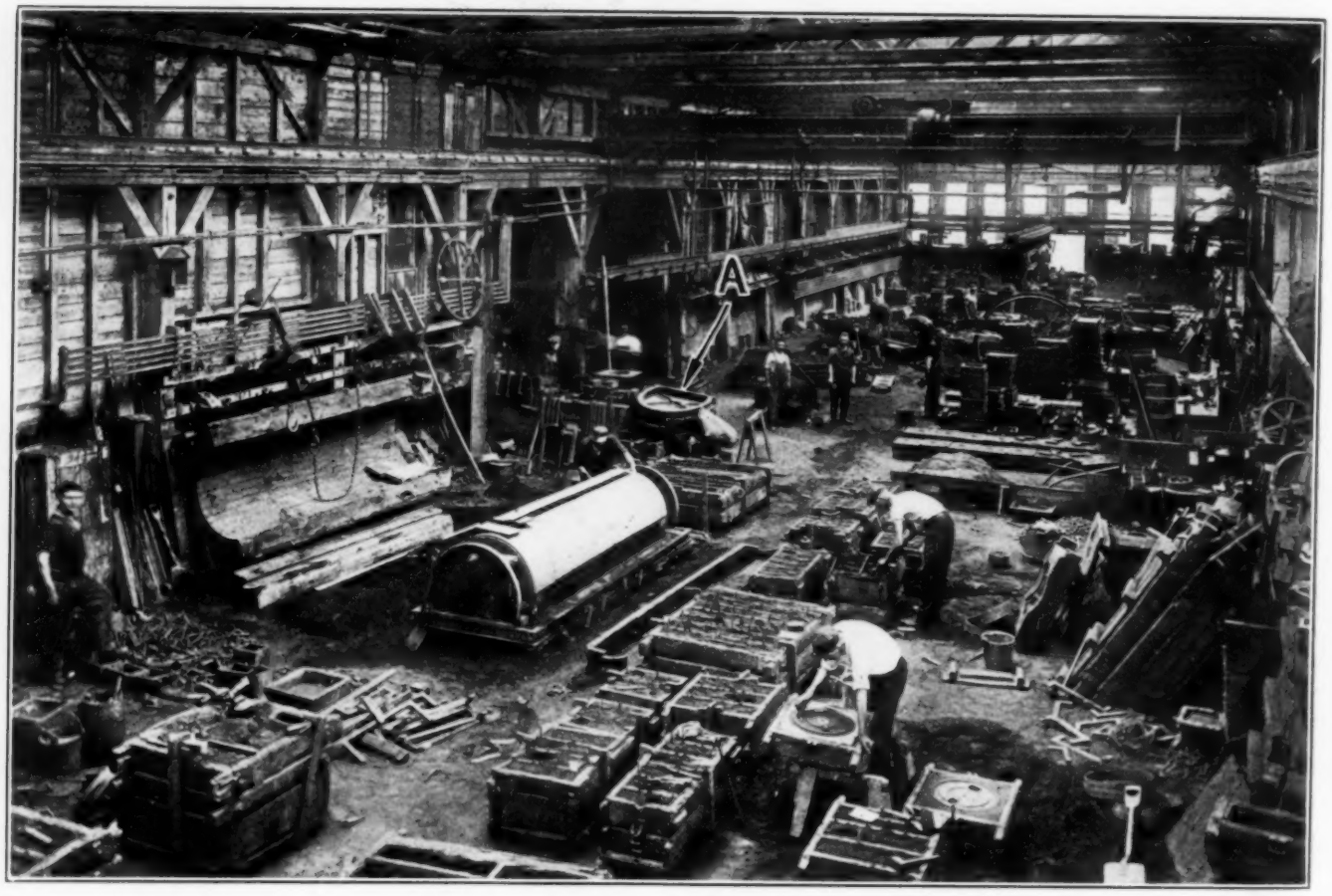


FIG. 5—GENERAL VIEW OF THE IRON FOUNDRY SHOWING METHOD OF SUPPORTING THE CRANE RUNWAYS—THE MONORAIL SYSTEM FOR DISTRIBUTING IRON TO THE SMALL WORK FLOORS IS SHOWN IN THE BACKGROUND

and flask pin fitting are illustrated in Fig. 3. The method of securing accuracy and rigidity in pins that are changed from one flask to another is shown at *B*. Pins of this character usually are made a loose fit to facilitate changing and for that reason it is difficult to secure an accurate fit between the cope and drag. The pin and socket shown at *B* furnish a simple solution for the problem. The socket is cast separately from the flask and afterward is bolted at any desired point. This eliminates the trouble incident to drilling holes in permanent lugs, parallel and uniform at opposite ends of a flask. Also where a lug, occasionally is broken it is cheaper to make a new lug than a new flask.

Many methods, some more ingenious than others have been tried by foundrymen in attaching guides to flasks. That shown at *B* Fig. 3 is accurate, easily made and may be inserted and removed with probably less trouble than any other. The pins are tapered slightly at one end and are cut to any convenient length from plain round stock. The straight end is lowered through both holes in the socket and then a small wood wedge is driven between the pin and the socket, thus securely fastening it in place. Jamming the pin in this manner not only tightens it in the socket, but it also takes up all the play in the cope guide and brings the pin into close contact with the outside of the opening. After the cope is closed on the drag the wedge may be backed out and the pin removed for service in another flask.

The matchboards shown at *C* and *D* Fig. 3, illustrates two methods usually employed for mounting small patterns either for hand or machine production. The half bushing pattern is attached to the plain board in such a manner that both halves of the mold may be rammed on the same half pattern and later when the two halves of the mold are assembled the joint edges will coincide perfectly. It will be noted that the upper pin hole on the board is slightly elongated to provide for variation in the distance between pins. The pin holes are drilled accurately on a center line and this feature together with the round hole at one end insure that there will be no shift in the casting.

Use Novel Matchboard

The vibrator frame and matchboard shown at *D* are typical or the manner in which patterns with irregular parting lines are fitted for economical molding. These castings never are ordered in large quantities and a molder may have to change from one pattern to another several times a day. In the method shown, the change is made readily and with practically no loss of time. The pattern plates are made to a standard size and thickness and may be attached to or detached from the vibrator frame by the insertion or removal of a few screws.

Under normal conditions the iron foundry has a capacity of 8 tons of castings per day. Various brands of pig iron and scrap are piled in an exceptionally neat and well ordered yard served by a spur track from the Boston & Maine railroad. The iron is made up in 2000-pound charges and melted in a 48-inch cupola supplied by the Whiting Corp., Harvey, Ill. The blast is furnished by a positive pressure blower made by the P. H. & F. M. Roots Co., Connersville, Ind. The general run of castings are made from a mixture approximating 50 per cent pig iron and 50 per cent scrap. For steam chests and cylinders, gears, etc., a semisteel mixture is employed made up of 20 per cent steel scrap, 25 per cent pig iron and 55 per cent scrap.

The brass foundry adjoins the iron foundry and is equipped in the usual manner for the production of small and medium size castings. Formerly the metal was melted in a battery of coke fired pit furnaces but on account of the exacting features of certain castings which were poured from two crucibles simultaneously the company some time ago installed an electric melting furnace made by the Booth Electric Furnace Co., Chicago. This furnace has a rated capacity of 250 pounds, but no trouble is experienced in melting at times a charge of 450 pounds. The heavy charge is only

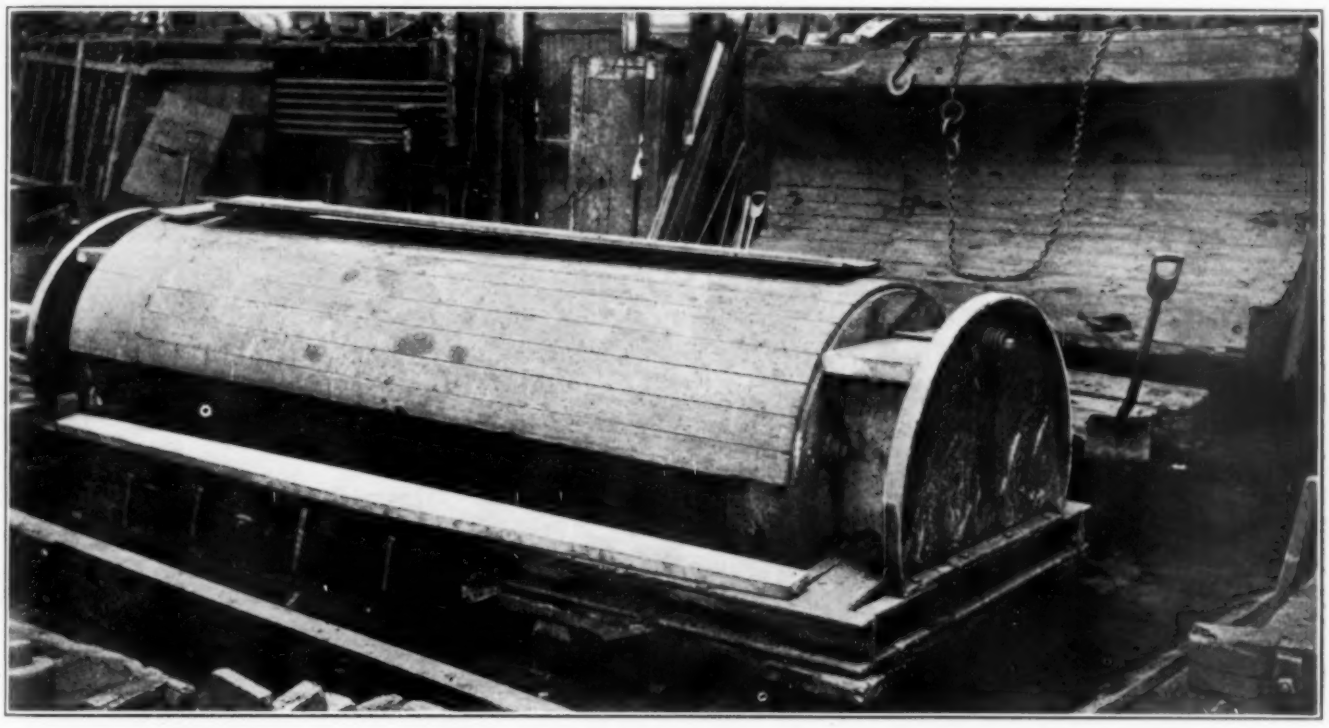


FIG. 6—THE PATTERN EQUIPMENT FOR MAKING A DRUM IS LIMITED TO A NUMBER OF LONG STAVES, A FOLLOWBOARD AND TWO HALF CORE BOXES

required occasionaly to pour a brass plate 26 x 54 x ¾ inch. This plate is attached to the face of a hydraulic press working under 3000 pounds pressure and is designed to impart a burnished finish to certain kinds of leather. The plate is machined and polished until it presents a mirror-like surface and the slightest pin hole or the least variation in uniformity, density or homogeneity will condemn it. Where the metal was melted in two crucibles, although all the material charged practically was the same and the charge was melted down under approximately the same conditions, slight variations in the character of the metal here and there throughout the surface occasionally were apparent. Since the station. It comes into the building at 2300 volts single phase and is stepped down to 110 volts. The furnace is of the two-carbon, arc, indirect heat type and the carbon is adapted to be fed either by hand or by automatic control. The amount of current used, of course, depends on whether the furnace is operated continuously or intermittently. On a typical day's run between 7:30 a. m., and 2:15 p. m. when three separate charges were melted, the charging sheet indicates that 40 kilowatts were consumed in preliminary heating and 90 kilowatts in addition were required to melt the first heat. The second heat consumed 79 kilowatts and the third heat only required 70. Presumably if there had been a fourth heat the current consumption would have been proportionally less. The composition in the first and third charges was similar and was designed for the general run of castings. The second charge was for one of the hydraulic press plates referred to previously. The weight of each of the component parts in the mixtures follows:

For General Castings	Pounds
Ingot copper	49
Selected Scrap	85
Gates	116
Chips	50
Tin	2½
Phosphor Tin	1½

Special Plate Metal	Pounds
Ingot copper	290
Gates	45
Chips	75
Tin	30
Zinc	15
Silicon Copper	1

The metal is drawn from the furnace into clay-lined ladles similar to those used in the iron foundry. One of the pit furnaces has been equipped with an oil burner and now serves as a ladle heater.

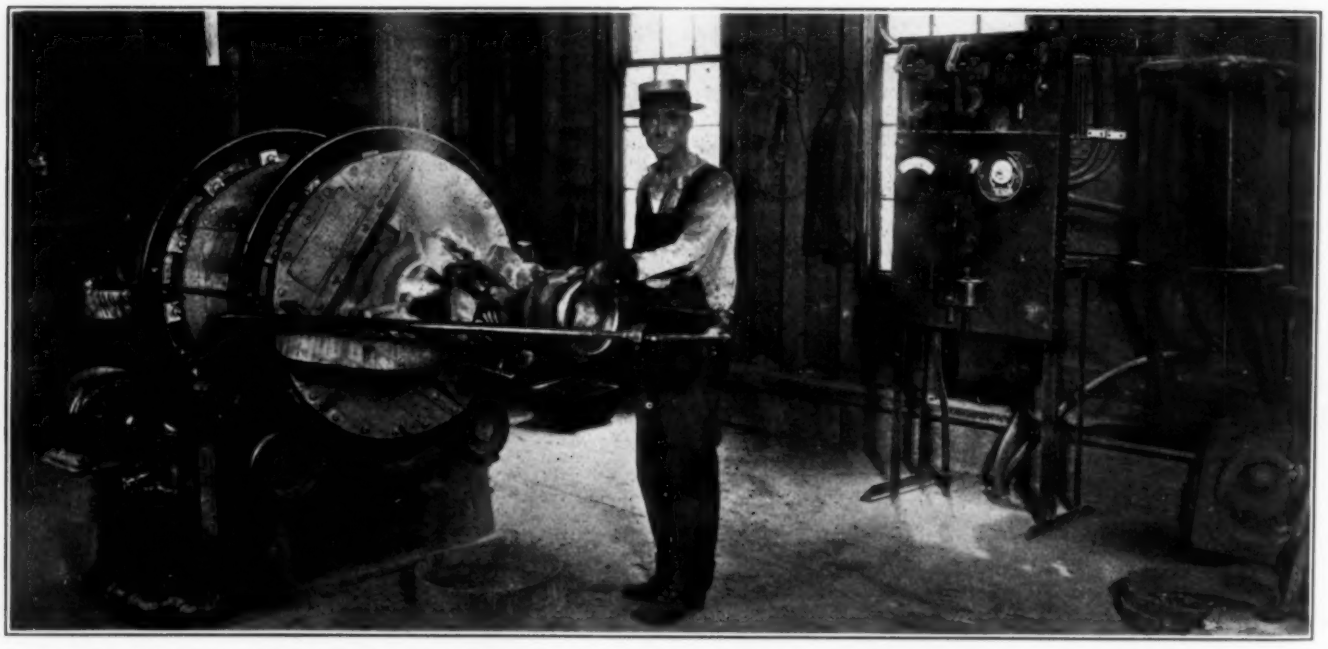


FIG. 7—THE BRASS MELTING FURNACE AND THE ELECTRICAL EQUIPMENT EMPLOYED IN CONNECTION WITH IT ARE LOCATED IN A ROOM WHICH OPENS INTO THE BRASS FOUNDRY MOLDING FLOOR

charge has been melted as a unit in the electric furnace no trouble has been experienced.

A casting that is made in large quantities is a flat brass band which later is attached to a long roll in the form of a spiral as illustrated in Fig. 4. The bands are cast flat, several in a flask and after they have been ground to a finish on both sides between two wheels they are inserted in a spiral groove in a long cast iron roll. A narrow strip of metal is placed beside the edge of the band in the spiral groove and a man with a hammer and calking tool fastens the band securely in place.

The company maintains its own power house and supplies all the direct current required for the operation of the various departments. Alternating current for the melting furnace is secured from the city power

Book Review

Chemical Resistance of Engineering Materials, by Marston Lovell Hamlin and Francis Mills Turner Jr.; cloth, 267 pages, 6 x 9 inches; published by the Chemical Catalog Co., Inc., New York, and furnished by THE FOUNDRY, Cleveland; price $5.

So little has been published in an easily obtainable form on the subject of chemical resistance of engineering materials that the authors have endeavored to present the subject in a full but not necessarily exhaustive way. This has been accomplished in a clear manner with data given to support statements and show the effects of different chemicals on various engineering materials. The brass foundryman would be specially interested in the books as many formulas of nonferrous alloys are given and the effects of acids and alkalies in numerous metals and alloys are explained, both qualatatively and quantatively. One chapter on the selection of materials for specific equipment, such as valves, vats and pumps, indicates the degree to which different metals and materials will resist the corrosion they would be subjected to in the various equipment.

Exchange Views on Practices

Representatives of Twelve Nations Discuss Foundry Problems at International Congress in Paris—Outline Procedure in Unifying Cast Iron Tests

AT the opening session of the International Foundrymen's congress in Paris on Sept, 12, the platform was occupied by the presidents of six great foundrymen's organizations representing the principal countries of the world. The seat of honor was accorded to Emile Ramas, president of the Association Technique de Fonderie de France, under the auspices of which the congress was held. G. H. Clamer, president of the American Foundrymen's association, represented the United States; Oliver Stubbs, president of the Institute of British Foundrymen, sat for the British Empire; Joseph Leonard, president of the Association Technique de Fonderie de Liege, represented Belgium; M. Vanzetti, president of the Italian Foundrymen's association, and Professor Piseck, president of the Association de Fonderie Tcheco-Slovaque, also were present. In addition, C. E. Hoyt, secretary of the American Foundrymen's association; W. G. Hollinworth, secretary of the Institute of British Foundrymen; and Camille Didier, secretary of the French association, attended, together with a number of the directors and members of council of several different associations. This is the first meeting in which the active heads and principal officers of so many foundrymen's organizations, from both Europe and America, ever participated. On no previous occasion were more than three associations officially represented. What is perhaps more important, in addition to the heads of the various organizations, each country was represented by a large delegation of practical foundrymen. The American corps consisted of about 40 persons; there were over 80 in the British group; Belgium was almost equally well represented; and there were sizable parties from Italy, Czecho-Slovakia, Spain, Switzerland, Holland, Sweden, and Denmark. French foundrymen attended to the number of nearly a thousand.

A Truly International Meeting

For Paris was reserved the honor of assembling the first truly international gathering of casting manufacturers ever held. An even dozen countries were represented. Although the first of its kind, the success of the Paris congress was so pronounced, that the idea of holding international conventions at periodic intervals in the future may now be said to be thoroughly established. During the congress, both Mr. Clamer and Mr. Stubbs stated repeatedly that the foundrymen of the world owe a great debt to their confreres in France, who in the midst of the great difficulties of postwar reconstruction, possessed both the initiative and energy necessary to make a reality out of what hitherto had been merely an idea. Although Messieurs Ramas, Lardin, Didier, and Ronceray, officers of the French association, generously attributed the success of the Paris meeting to the co-operation of so many other foundrymen's organizations in all parts of the world, the fact remains that the Association Technique de Fonderie is the first organization to bring together foundrymen from more than two or three countries, and therefore the first to hold a thoroughly international convention in which both the chief officers and rank and file of the principal countries in the northern hemisphere participated.

Testing First Considered

Among the subjects discussed at the Paris congress, the important question of an internationally acceptable method of testing cast iron occupied first place. The problem of grading pig iron sold for export according to analysis, also was dealt with, and papers were read on a great variety of subjects. Sand handling and preparation attracted considerable attention, and papers also were contributed on apprenticeship problems, malleable castings, foundry costs, aluminum bronzes, magnesium castings, and other subjects. The first session was held Wednesday, Sept. 12, and the last on Saturday morning, Sept. 15. Throughout the week interesting social functions took place, and a number of the principal foundries near Paris were visited. The entertainment features, which included trips for the ladies to the Louvre and Luxembourg galleries, and visits to the Conservatory of Art and Science, the Invalides museum, and the Eiffel tower, culminated in a brilliant banquet at the Palais d'Orsay hotel. Addresses were made at the banquet by the officers of the various associations represented at the congress expressing the community of thought and spirit which prevails among the foundrymen of the western nations.

The congress was held at the Ecole Nationale d'Arts et Metiers in conjunction with a comprehensive exhibition of foundry equipment and supplies which was fully described in the Oct. 1 issue of THE FOUNDRY. During the week competitions in molding, patternmaking, etc., were held in the school shops.

With so many of the foreign visitors either Americans or Britishers, the interest of the overseas delegations centered in the English-speaking ses-

Testing Cast Iron

RESOLVED, *that the International Congress of Foundrymen assembled in Paris recommends that in the testing of cast iron the testing of the quality of the iron entering the castings be differentiated from the testing of the quality of the castings themselves.*

BE IT FURTHER RESOLVED, *that immediate steps be taken to study both branches of the problem side by side, with the expectation that the problem of testing the quality of the iron will be solved earlier than that of testing the castings themselves. It is recognized that in no case will the testing of the quality of the iron give reliable information as to the quality of the castings made from it.*

BE IT FURTHER RESOLVED, *that a joint committee be appointed from the nations represented in Paris to make suitable recommendations for carrying this proposal into effect.*

BE IT FURTHER RESOLVED, *that the purchase and sale of pig iron for export be conducted on the basis of analysis. This should be done under appropriate regulations which will protect both the buyers and sellers in connection with methods of sampling and analysis. Allowable variations from the analysis prescribed should be specified.*

sion which was held Thursday morning, Sept. 13. Messrs. Clamer and Stubbs acted as joint chairmen, and Messers. Hoyt and Hollinworth as joint honorary secretaries. The congress as a whole had been opened on the previous day by Gaston Vidal, under-secretary of state for technical education. G. H. Clamer, president of the American Foundrymen's association and Oliver Stubbs, president of the I. B. F., responded to M. Vidal's address of welcome.

Eight papers were read and discussed at the English-speaking session. They were contributed by members of the Institute of British Foundrymen and American Foundrymen's association. In addition to being presented at the English session, these papers also were translated and read in the French sessions. They were discussed, therefore, by both English and French speaking foundrymen.

The first paper read at the English speaking session on Thursday morning was that by Dr. Richard Moldenke, Watchung, N. J., entitled "Testing Cast Iron." In this paper an effort is made to state the American position with reference to the adoption of an international test bar. After reviewing the history of the testing of cast iron, including an outline of the development of the American arbitration bar, the paper proceeds, in part, as follows:

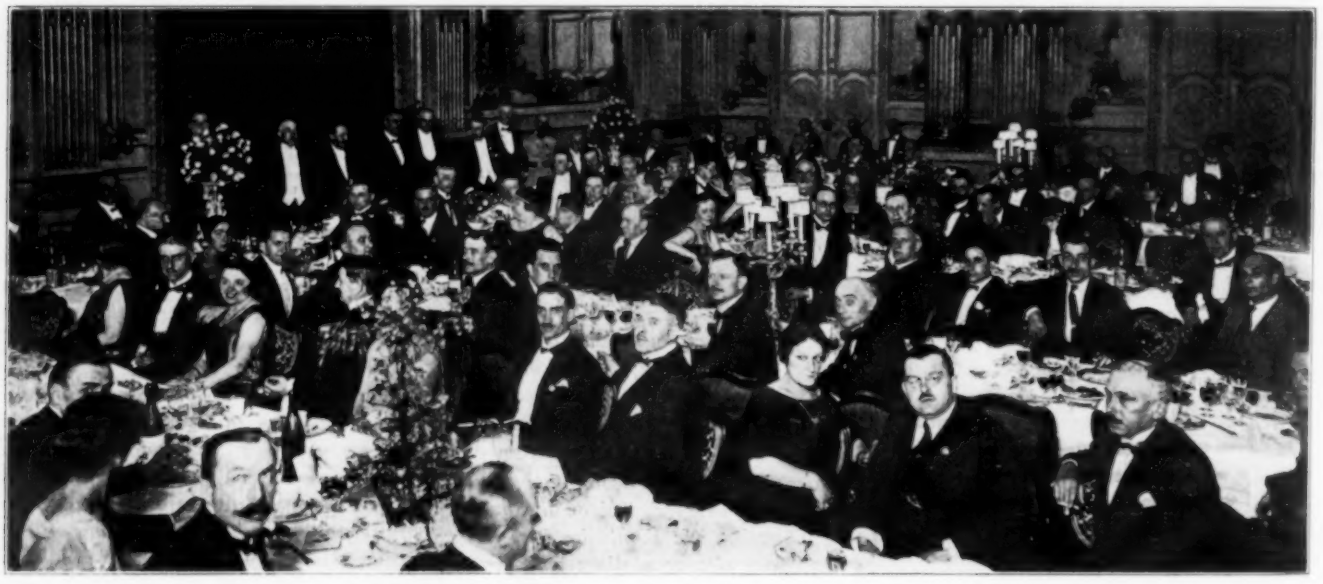
"Be it understood that the American standard arbitration test bar never has, and never will replace the test bars used in individual foundries which are loth to give up their individual preferences. But for universal comparison of results it is essential that a standard be adopted with which all other bars can be correlated by the use of suitable factors. A national standard may even consist of several bars of different cross sections to provide for an extended silicon range and thus cover a wider range of castings than a single bar; but when it comes to an international standard, it would seem essential that but one bar be selected which would cover the metal going into castings used for machinery, rather than to provide for such special work as chilled rolls, crusher parts, or the very lightest and thinnest castings in which strength is not essential.

"American foundrymen and engineers are now ready to consider the lengthening of the arbitration bar, possibly increasing the diameter somewhat at the same time. They will be glad, however, to await international action on this point, so that when an international arbitration test bar is adopted, it may possibly be acceptable as the American national bar.

"The length of an international bar will probably be a matter of compromise as nations using short bars will yield some increase, just as nations using very long bars will agree to a shortening. The International Association for Testing Materials once proposed an international test bar with dimensions which would be readily convertible in English and metric measurments. It was to be tested on supports 18 inches or 45 centimeters apart. The bar itself was to be at least 20 inches or 50 centimeters long, to be safe in case the mold was poured short. From the reports of testing societies in various countries this length of bar seems to be generally acceptable, and it is suggested as a basis for discussion when this matter of an international test bar is taken up seriously for settlement. The question of the diameter of the test bar is one which may require some further study on the part of the interested foundrymen and engineers of the world. The bar originally proposed was to be 1.1 inches or 30 millimeters in diameter."

J. Shaw, Brightside Foundry & Engineering Co., Sheffield, opened the discussion by pointing out that although the Fremont and Portevin method of testing (by subjecting small cylinders cut direct from the casting to shearing stresses) has been before the foundry public since 1909, it has found only limited adoption, even in France. In the opinion of Mr. Shaw it is not a practical test. Mr. Shaw said he recognized that the American methods of testing are simple and practical, but declared that American foundrymen do not use the arbitration bar. Explaining why the British foundrymen propose three sizes of test bars for thin, medium, and thick castings, respectively. Mr. Shaw presented curves showing how strength recorded varies with the size of test bar. Iron suitable for thin, strong castings showed 29,000 pounds strength on a ⅝-inch bar dropping to 19,000 pounds on a 3-inch bar; an iron suitable for castings 1½ inches thick containing about 1½ per cent silicon showed 21,000 pounds per square inch on a ⅝-inch bar, 27,000 pounds on a 1½-inch bar, and only 19,000 pounds on a 3-inch bar. A curve also was exhibited by Mr. Shaw showing the effect of combined carbon on strength indicating that iron with 0.7 per cent of combined carbon is the strongest. The English foundry industry, said Mr. Shaw, has been dominated by engineers for 100 years, and their influence is an important factor when it comes to devising tests which will satisfy British buyers of castings.

E. V. Ronceray, Ph. Bonvillian & E. Ronceray, Choisy-le-Roi, near Paris, supported the opinion that no test bar can be made to represent the casting.



THE BANQUET AT PALAIS D'ORSEY MARKED THE CLIMAX OF THE INTERNATIONAL CONGRESS

At the speakers' table, from left to right, G. H. Clamer, President, A. F. A.; Emile Ramas, President, A. T. F.; Gaston Vidal, Under Secretary of State, France, a French Government Representative; Oliver Stubbs, President, I. B. F.; M. Corre, Director, Ecole Arts et Metiers

The virtue of the Fremont test, he indicated, lies in the fact that an actual portion of the casting itself is tested. He intimated that the representation of important castings by test bars cast separately is a dangerous practice. As far as meeting the views of engineers is concerned, foundrymen can get their views adopted if they work together throughout the world.

William Jolley, Metropolitan Vickers Electrical Co., Manchester, said no intelligent engineer believes that a test bar represents the casting; what it shows is the kind of metal used.

Walter Wood, R. D. Wood & Co., Philadelphia, said the Fremont Portevin method has great scientific value and is often practically useful. He explained that the arbitration bar is simply a common denominator to which results obtained on bars of other sizes can be reduced by using proper coefficients.

Plants Visited

THE following plants in Paris and vicinity were visited during the International Foundrymen's congress at Paris, Sept. 12-15. *They included open-hearth, converter, and electric steel foundries; brass, bronze, and aluminum shops; and gray-iron foundries.*

Fonderies de Paris et de la Seine

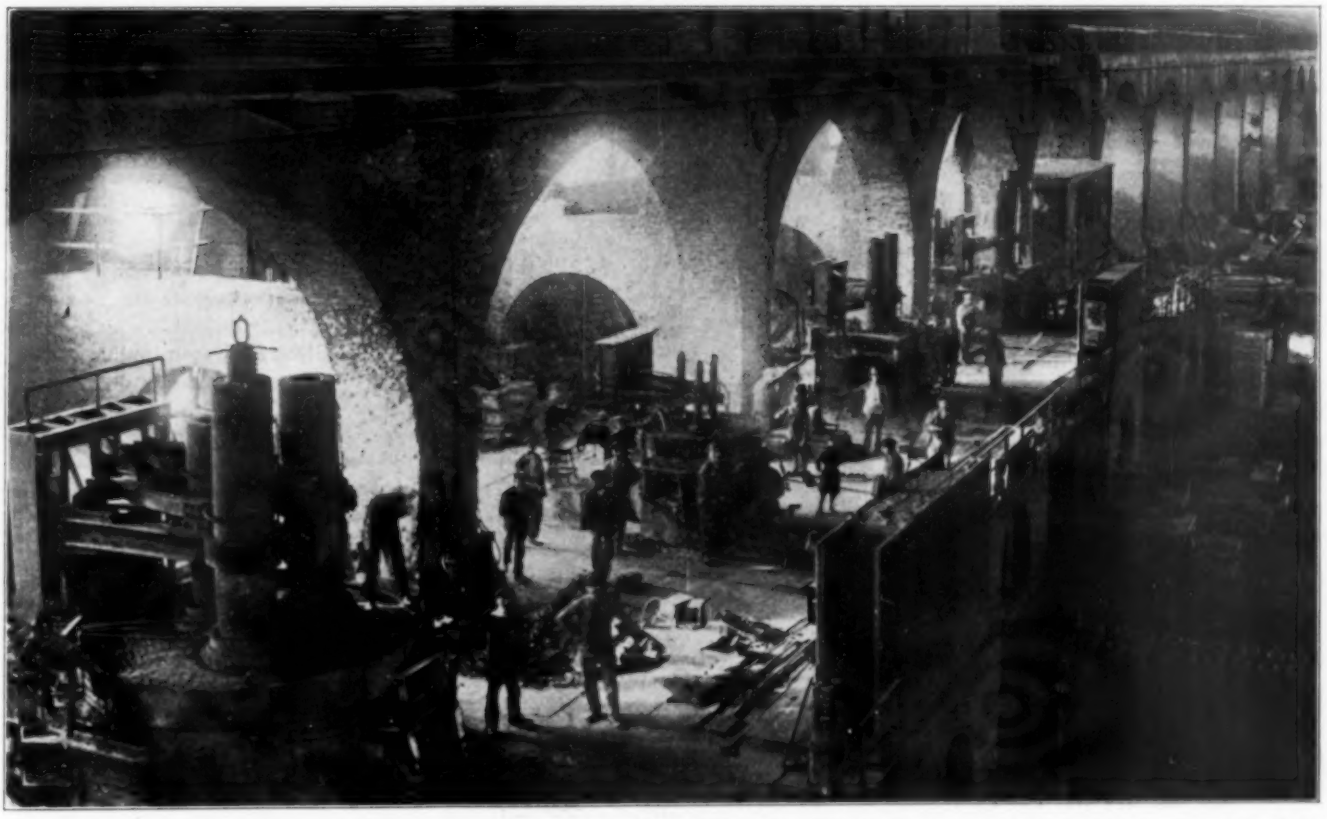
Forges et Fonderies de l'Aviation

Ateliers Nord-Paris

La Metallurgique Electrique

Usines Vitry-sur-Seine

Etablissements Bonvillain et Ronceray



NUMEROUS REPRESENTATIVE FOUNDRIES THROUGHOUT FRANCE AND BELGIUM WERE VISITED BY THE AMERICAN PARTY PREVIOUS TO THE RETURN OF SOME OF THE TOURISTS ON OCTOBER 3

In the French session on the previous day, Prof. Albert Portevin, himself said that the problem of testing cast iron must be considered from two standpoints, first the quality of the iron entering into the castings, and secondly the quality of the castings themselves. Most American tests relate to the first problem, while French researches have dealt more with the second. M. Portevin, who is now in consulting practice in Paris, conceded that the test of a casting itself must necessarily be local because the character of the metal varies from point to point according to thickness of section, shape, etc. But he pointed out it is necessary to know something about the metal in the casting as well as in a test bar, and for this purpose the researches of Fremont are valuable.

In order to make further progress on this problem, and in view of the considerable difference of opinion which now exists, a resolution was introduced and passed at both the opening French session and the English-speaking session suggesting a definite course of action for the future. It was made clear that the congress had no power to more than recommend that each of the associations in the several countries concerned should work along the lines indicated. Tangible results must come from the individual action of the various national associations. The text of the resolution is given in full on page 817. It was passed unanimously at both sessions and was supported by G. H. Clamer, president of the A. F. A.; E. Ramas, president of the A. T. F.; M. Vanzetti, head of the Italian association; Prof. Piseck, president of the Czecho-Slovakian foundrymen, and others. Oliver Stubbs supported the resolution for the I. B. F., but pointed out that no new committee is needed. The existing committees on testing cast iron of the several national associations, he suggested, should form the nucleus of any international body. This was agreed. An informal meeting of members of the various national testing committees, looking toward the formation of an international steering committee, was held on Saturday afternoon, Sept. 15. Preliminary steps were taken at this meeting.

Next to the testing of cast iron,

the most important question taken up at the English-speaking session was the bonding and composition of molding sands. The official exchange paper from the American Foundrymen's association to the French association by H. B. Hanley, foundry engineer, Rochester, N. Y., dealt with this subject. This paper is entitled, "The Bonding Substance of Molding Sands; Its Composition, Properties, and Tests." This was published on page 745 of the Sept. 15 issue of THE FOUNDRY. H. Holmes, Birtley Iron Co., Birtley, England, read a paper entitled, "The Standardization of Molding Sand Tests." This paper describes methods of grading sand by ordinary sieve tests, by using sieves with circular holes, and by washing with water, called deflocculation. The author states that the dye adsorption test has only a limited value. In conclusion he pleads for the international standardization of molding sand tests, using metric units of measurement. A third English paper on sand also was presented, by H. M. Lane, H. M. Lane Co., Detroit. It deals with the preparation of sand for continuous foundries, and its handling in both continuous and noncontinuous shops. It was agreed that on account of their importance and the necessity for making a careful study of the subject, the discussion of Mr. Hanley's and Mr. Holmes' papers should be confined to written communications submitted after the congress adjourned.

An exceedingly interesting paper on mass effect in cast iron was submitted by O. Smalley, Sir W. G. Armstrong, Whitworth & Co., Newcastle-on-Tyne, on behalf of the Institute of British Foundrymen. This paper is presented on page 822 of this issue of THE FOUNDRY. It deals in a comprehensive manner with the laws of heat transfer and mass action in cooling metals.

Specific Gravity Tests

In opening the discussion, H. Holmes, Birtley, England, said that the most careful studies and tests could not determine whether the interior of a casting of heavy section is sound or not. Mr. Holmes suggested testing such castings by determining their specific gravity and comparing it with the known specific gravity of solid cast iron. He also said a casting may become unsound as a result of increases in volume due to yielding and enlargement of the mold, aside from volume changes due to solidification. On the other hand if the mold is strong, the casting may crack. It is almost impossible, therefore, to make certain shaped big castings perfectly sound in every section.

Wesley Lambert, J. Stone & Co., London, pointed out that Mr. Smalley's paper is one of the first to be written on mass effect. It also represents a research made under actual foundry as distinguished from laboratory conditions.

Dr. J. E. Fletcher, Birmingham, late director of research of the British Cast Iron Research association, called attention to the importance which Mr. Smalley attaches to the latent heat of fusion of cast iron. Manganese, he said, has an appreciable effect on the rate of cooling, as has been proved by experiments on castings containing large percentages of this element.

NOVEL DEVELOPMENTS IN FOUNDRY PRACTICE WERE NOTED—IN THIS CASE A LADLE BECOMES AN IMPROVISED ELECTRIC FURNACE

Mass effect studies, Dr. Fletcher concluded, lead directly to considering the design of large castings and the effect of the juxtaposition of thick and thin sections.

In reply to the discussion Mr. Smalley said that the hard skin formed by the quick cooling in green sand or partially dried molds may reverse the effect of any yielding of the mold.

A paper on magnesium was read by H. J. Maybrey, Magnesium Co., London. Most methods of manufacturing magnesium today, this paper states, are based on the electrolysis of fused anhydrous magnesium chloride. Other methods employing distillation are also in use. The requisite ores for these processes are widely distributed and exist in enormous quantities. On account of the great affinity for oxygen, magnesium alloys must be melted with great care in uncoated, tightly covered iron or steel pots. The metal may be cast either in permanent or sand molds. The latter, in the opinion of the author, must be thoroughly dried.

Mr. Engberg of the Swedish Foundrymen's association, in discussing this paper, described a German method used in Sweden for casting magnesium alloys in green-sand molds, by mixing the sand with sulphur and other elements which form a neutral atmosphere in the mold.

Wesley Lambert, London, referred to the trouble encountered when impure magnesium is used. Some metal containing only 95 per cent magnesium has been marketed, he declared. Aluminum-magnesium castings made with impure metal are almost certain to prove unsatisfactory in service.

Papers were also read by Lieut. Col. Jaime Coll, Sevilla, Spain, on "Cupola Reactions, Further Research Wanted," and by E. Adamson, engineer, Sheffield, entitled, "Graphitization in Cast Iron."

At the conclusion of the English-speaking session, a resolution was passed extending profound sympathy to the Japanese people on account of the recent earthquake, a copy being sent to the Japanese ambassador in Paris.

At the French Sessions

At the first session in French on Sept. 13, Leon Thomas, Soissons foundry, Etablissements les fils de A. Piat, read a paper entitled, "The Foundry Superintendent's Task." This paper criticizes the old-fashioned methods which still prevail in many French foundries, but also points out that an increasing number of shops are adopting new methods. The author mentions one plant in which the materials used are handled by conveyors on four different levels, molds being made and poured on two floors. The necessity for high grade management is emphasized in the paper.

The discussion centered largely around sand handling questions. Jean Carle, Fonderie Pied-Selle, near Amiens, France, asked what is considered the most efficient device for the mechanical handling of prepared sand without clogging. He also inquired about the construction of overhead sand hoppers. H. M. Lane, in reply said he prefers to handle the sand in boxes carried by electric trucks, overhead trolleys, etc. Mr. Lane said the overhead bins which feed the molding machines should have vertical walls if possible, at least on the front, and as large a cross section

as possible. Ivan Lamoureux, Societe des Ateliers Lamoureux, Liege, Belgium, said the bins should be lined with zinc. It was pointed out that steel and concrete are the principal materials now used in America.

A paper by M. Ledesert, Compagnie Fives Lille pour Constructions Mecaniques, Paris, on "Methods of Testing Castings," was referred to the testing committee of the A. T. F. with the suggestion that it be studied in connection with the problem of an internationally standardized method of testing cast iron. The author suggests a method of taking test pieces out of the castings so that the results obtained will be comparable.

The second French session was presided over by Joseph Leonard, president of the Association Technique de Fonderie de Liege. Professor Pisek, president of the Association de Fonderie Tcheco-Slovaque announced that on his return, a committee would be named in Czecho-Slovakia to co-operate on the standardization of tests for cast iron.

A paper was read by A. Lely, consulting engineer, Paris, on "The Destruction and the Reconstruction of Foundries in the Devastated Regions." The subject naturally aroused sympathetic comments from the representatives of the different nations who were present.

Consider Alloys

M. Pisek, professor at the Ecole Polytechnique at Brno, and president of the Czecho-Slovakian Foundrymen's association, followed with a paper offering a comprehensive study of "Alloys Considered as Material for the Manufacture of Castings for Machinery." The paper first covers considerations and the physical properties of alloys in general. Then the author takes up separately the subjects of cast iron, cast steel, copper alloys, bronze, brass, aluminum bronze, white metal, and aluminum alloys. This is only part of a considerable work which Professor Pisek is completing. M. Portevin pointed out the great help derived in the study of alloys from metallography, including their examination with the naked eye. He also recalled that the properties of alloys in the liquid state are not yet well known scientifically, but that in many foundries certain tests are made which give a fair idea of the conditions of fluidity; this shows the advisability of closer contact between those who pursue scientific researches and the practical men. Joseph Leonard said that it is necessary to facilitate the study of metallography by foundrymen and that the various technical associations could be of great help in this direction.

The next paper on the program, entitled "A Revision of the Strength Limits Adopted for Cast Iron," was by Lieut. Col. Jaime Coll, of the Spanish Army, Engineer corps, Seville, Spain. The author is of the opinion that the present limit of 1.5 kilos per square millimeter or 21,330 pounds per square inch tensile strength imposed by French specifications could be considerably exceeded, since castings are now made in a more scientific manner than in the past. M. Portevin recalled the fact that in the majority of cases the tests are made in bars which are molded apart from the casting, consequently the user has really no idea of the resistence of the casting itself and will take no chances. The question of the standardization of tests of cast iron was brought up again and the considerable importance of this problem was re-emphasized by M. Portevin.

J. Varlet, Etablissements Esperance-Longdoz, Liege, Belgium, reported on the competitions which were organized for apprentices in 1922 and 1923 by the Association Technique de Fonderie de Liege. M. Varlet said that the organization of such competitions is delicate and that much experience can be gained by the organizers themselves when the competitions take place.

J. Cury, vice president of the Association Technique de Fonderie de France, occupied the chair for the session on Friday, Sept. 14.

L. Piedboeuf, foundry proprietor, Herstal-lez-Liege, Belgium, read a paper on behalf of the Association Technique de Fonderie de Liege, on tensile and bending tests for white-heart malleable cast iron. The conclusions of his researches are: (1) That cylindrical test pieces for tensile tests are not satisfactory for white-heart malleable castings of small sections; (2) the best results are obtained with test pieces having an H-section; (3) the same H-section also gives the best results for bending tests; (4) generally speaking, it is always advisable to adopt test pieces which have as small a width as possible, and to avoid sections which are circular, eliptical, or rectangular.

Marcel Remy, malleable foundry proprietor of Herstal, Belgium, was of the opinion that cylindrical test pieces could be used to advantage, providing the sections are in proportion to the dimensions of the castings. Professor Portevin, pointing out that several of the tensile tests reported in the paper were without meaning, owing to local defects, maintained that the tensile tests should be prohibited.

American Malleable in Europe

M. Gailly, foundry proprietor at Charleville, Ardennes, France, read a paper entitled, "Making American Malleable Castings in Europe." The author studied American methods in the United States and is at present the only manufacturer of American malleable castings in France. He first expressed his appreciation of the cordial reception he received while visiting the United States. He then pointed out that owing to the difference in the annealing processes in America and in Europe, European malleable cast iron has a pearlitic zone in the center, which reduces the malleability, whereas American malleable contains only ferrite and graphite. M. Gailly uses Walker's test for malleability and he recommended the American type of test piece, for its thickness is comparable to that of many automobile and agricultural implement parts. Marcel Remy, after recalling that the study and introduction of American methods for the manufacture of malleable iron in France were due to the initiative of the French and Belgian foundry associations, stated that it is possible to avoid the formation of pearlite without oxidizing the surface of the castings, by using an attenuated oxidizing mixture and by prolonging the time of heating. With reference to test pieces, M. Remy stated that elongations of 20 per cent had been obtained on test pieces which were only 5 millimeters thick. He stated also that if American malleable cast iron is heated beyond a certain degree this would cause a new formation of combined carbon. E. V.

Form Association

AT THE call of Marcel Remy, a producer of malleable iron castings with a foundry at Herstalles-Liege, Belgium, malleable iron foundrymen of Europe met during the International Foundrymen's convention, held in Paris, Sept. 12 to 15. The object was to form an association of producers of malleable iron which would raise the standard of malleable in Europe, controlling its manufacture, improving the process, and formulating specifications. A program of work was outlined, which includes a study of annealing methods which now are practiced.

Studies Mass Effect on Iron

Tests Made To Determine the Chemical and Physical Phenomena Occurring in Cast Iron as Affected by Rate of Cooling—Pouring Temperature and Rate of Filling Mold Shown to be Factors

BY O. SMALLEY

THE information available regarding the chemical and physical phenomena occurring in cast iron, as affected by rate of cooling, is meagre. However, it is well known that large castings present many difficulties which do not exist in producing small castings. It also is known that the molecular changes of gray iron on solidification are both complex and uncertain, and that the properties of a casting will be determined by their nature and magnitude; that is, the strength and solidity bear some relation to the time and temperature of the metal solidifying in the mold.

The author is not aware of any attempt at systematic investigation of the mass problem. It assumes proportions of huge dimension, and presents a fertile field for research to which the contributed co-operative effort of many investigators is necessary for its scientific understanding. This paper, then, does not more than present the subject as a whole for discussion, and indicates the mode of attack made by the author.

Technically, the laws involved in this study are those of mass action and heat transfer. The law of mass action tells us when and in what direction an equilibrium will be changed by an increase of concentration; that is, a pressure of any one component of a chemical reaction. The complexities of this with regard to cast iron are only too well known. The law of heat transfer is even more involved. The governing factors in the transfer of heat between the fluid metal and the mold which affect the solidity of a casting are:

The degree of superheat in the metal;
Its latent heat value;
Volume changes on solidification;
Dimension and form of casting;
Initial temperature of the mold;
Heat conductivity of the material from which the mold is made;
Heat capacity of the mold.

Difficult of Expression

These factors are not represented easily by a single term, and always will render the law of relation between mass and the physical properties difficult of mathematical expression. Such variables make it impossible to consider the laws to any length in our present state of knowledge of the subject, and the author only essays to project the more salient practical aspects of the mass problem, which are of immediate importance to both engineer and foundrymen, namely:

The time factor for various sections of cast iron to solidify under known condition;

The effect of chemical composition on the solidity penetrating power of gray cast iron;

The relation between the chemical and structural changes as effected by time and temperature; that is, to correlate texture with rate of cooling and discuss the means permitted in the control of the same;

To consider briefly the adoption of some simple standard of solidity and to proceed from this to discuss the effect of design on the strength in normal casting;

The rate of running to the mass effect, and to discuss its possibilities and limitations in its application of the manufacture of solid castings without risers.

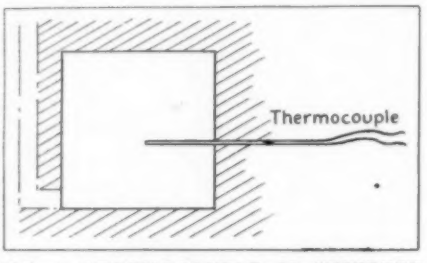


FIG. 1—THERMOCOUPLE IS INSERTED IN MOLD TO MEASURE COOLING RATE OF CASTING

Time Is Studied

The object of this investigation should be understood clearly. It is to ascertain the time taken for various sections of cast iron to solidify under known conditions. For purposes of comparative data as many variables as possible have been eliminated, excepting the one under consideration in each case. As it was essential to obtain some degree of accuracy, laboratory conditions were reproduced as closely as possible. The section chosen was the ordinary square commencing with 2, 4, 6 and 8 inches respectively. The molds were made in dry sand and consisted of 12 parts of ordinary floor sand, 8 parts of earth loam and 2 parts of saw dust thoroughly mixed together.

These were baked at 400 degrees Fahr. and allowed to cool to 100 degrees for castings. Each mold was made under similar conditions and well vented. A platinum, platinum-rhodium thermocouple was placed in the mold, as shown by Fig. 1, and cast in the center of the block so that the recorded time temperature figures would represent the conditions operating in the mold from incipient solidification to room temperature.

Delicate Heat Measurement

The thermocouples used were made from the same batch of wire and calibrated to a standard instrument to an accurate of plus or minus 2 degrees at 2370 degrees Fahr. The thermocouple was protected by means of a fine silica tube fastened in the mold. The metal was melted in an 8-ton cupola using the following mixture:

448 pounds East-coast hematite, pig iron, mixed numbers.
672 pounds Cleveland pig iron.
1120 pounds machinery scrap.

This was calculated to yield the following composition:

	Per Cent
Total carbon	3.2 to 3.5
Silicon	2.0
Manganese	0.7
Phosphorus	0.9
Sulphur	0.06

The temperature of the metal on leaving the cupola was 2515 degrees Fahr. It was run into a 1-ton ladle and each casting was poured at approximately 2400 degrees Fahr. Each block was poured quickly from the bottom, the area of the ingate being adjusted so that the time to fill each mold would be approximately similar.

Time readings were commenced from the maximum temperature recorded by the pyrometer measuring the time for every fall of 20 degrees Fahr. Curves *A*, *B*, and *C*, Fig. 2, represent the time-temperature curves obtained from these blocks. Details of the relative time occupied in the solidification of each are as follows:

Temperature Range	Time—Min.	Time—Sec.
2 and 4-inch Blocks		
Main solidification: 2130 to 2078 degrees Fahr.	10	35
Incipient solidification to phosphide eutectoid: 2130 to 1715 degrees Fahr.	23	15

Abstract of an article presented at the International Foundrymen's congress, held in Paris, Sept. 12 to 15.

6-Inch Block		
Main solidification: 2160 to 2060 degrees Fahr.	28	42
Incipient solidification to phosphide eutectoid: 2160 to 1715 degrees Fahr.	65	65
8-Inch Block		
Main solidification: 2180 to 2060 degrees Fahr.	63	..
Incipient solidification to phosphide eutectoid: 2180 to 1715 degrees Fahr.	145	..

It may be observed that the time occupied during solidification of large masses of iron may reach alarming figures and that, even for ordinary castings, ample opportunity is given for manifestation of the principal operative forces in the mold responsible for the commoner metallurgical defects; namely, volume changes on solidification, expansion or contraction, crystallization, and liquidation.

Makes Test Blocks

To determine the part played by chemical composition on mass effect as far as solidity is concerned, a set of 6-inch cubes was cast in dry-sand molds poured from the bottom, and at the same rate and under similar conditions as far as was practicable. The temperature of each mold on casting was controlled between 100 and 110 degrees Fahr.

The series contained irons of the following composition:

	1	2	3
Total carbon	3.12	3.27	3.40
Silicon	2.49	1.15	1.20
Manganese	0.52	0.62	0.63
Phosphorus	1.28	1.54	0.09
Sulphur	0.050	0.086	0.063

Each was melted in an 8-ton cupola and poured with 10 per cent superheat. Etchings taken from each cube, after sectioning vertically through the middle, showed that iron No. 3, containing 1.20 per cent silicon and 1.09 per cent phosphorus, was equally solid throughout, while the others were more open grained toward the center.

Where adjustments of the ordinary chemical elements, silicon, sulphur, phosphorus and manganese are limited, the degree of solidity penetrating power may be increased by the introduction of special metals such as copper, nickel, chromium, molybdenum and tungsten. To illustrate this point in a more practical way, a series of castings of *T* section was made. When cast in an ordinary soft gray iron, this section invariably exhibits an open texture in the center of the heavy section. When nickel or chromium were added the *T* sections showed that both of the elements not only eliminate the draw at the heavy section, but have resulted in a uniform grain throughout. The relative solidity penetrating power of the two elements may be determined by brinell tests.

In a previous research on this subject the author has been able to show that cupola-melted gray iron of normal chemical composition does not draw on solidification if poured with a sufficient degree of superheat, and if cooled faster than a certain critical rate. In other words, there exists for each grade of cast iron a minimum rate of cooling during solidification which yields, within practical limits, the same grain or density, regardless of section or dimension of the casting when poured with a suitable degree of superheat. What these permitted minimum critical rate of cooling and range of superheat are remains to be scientifically determined, while the explanation of the chemicophysical reactions involved is still a matter of conjecture.

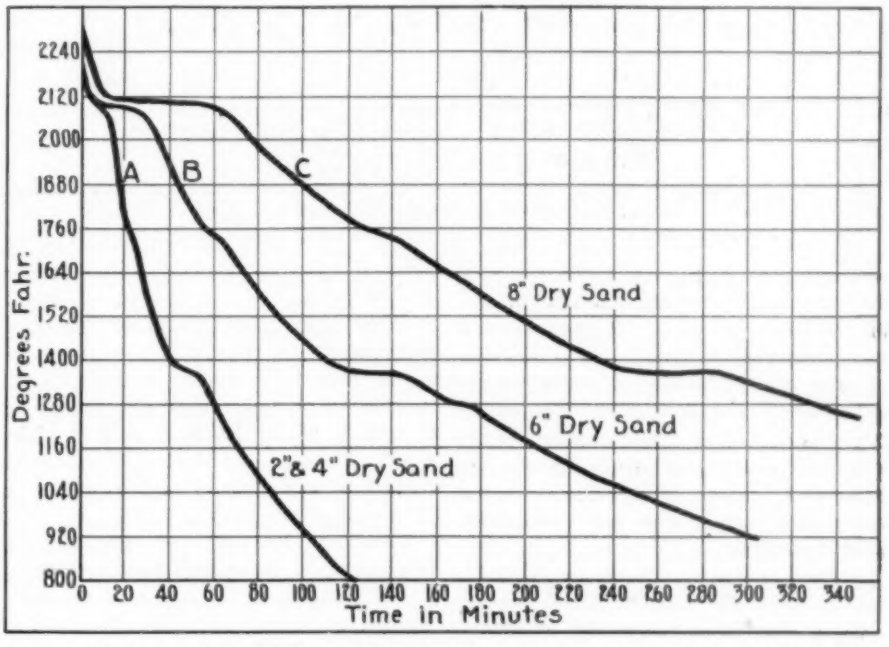


FIG. 2—TIME-TEMPERATURE CURVES OF BLOCKS OF CAST IRON OF DIFFERENT DIMENSIONS

This investigation, once systematically conducted, would provide information that would permit both the engineer and foundryman to specify the grade of iron and the method of construction of the mold to insure the strength and solidity throughout all sections of any casting. This is one of the important researches confronting the Cast Iron Research association, and until such data is forthcoming, the engineer is in the hands of the foundryman, who is restricted by the limitations of his training and past experience.

Broughall, in his well known researches on denseners deals with the practical aspect of the question, and shows how, by speeding solidification of the outer shell of the casting, the natural expansion of the metal is resisted and results in a casting of considerable density.

His theory is that immediately the iron is poured into the chill mold, considerable and definite expansion of the iron takes place, which, being resisted by the mold, is converted into a compressive force which submits the casting to such a tremendous pressure, that the density of the iron is increased. It has been proved repeatedly that rapid cooling does affect this densening, and the author already has shown that it is possible to make any gray iron casting sound, provided that the metal is hot enough, and the rate of cooling sufficiently rapid. The explanation given by Mr. Broughall of the reversal of the expansion forces by the rigidity of the mold, however, remains to be proved, for gray iron may be cast in a rigid mold and present both a pipe and an internal draw.

The author inclines to the view that the rigidity of the mold does not enter into the question, but that the non-contracting properties and solidity of gray iron, when poured hot and rapidly cooled, are an effect of, first, a time-temperature balance reaction between the constituents present—chiefly carbon—and the dissolved gas, this latter being retained in solution under considerable pressure and second, of supercooling.

Casts Cube in Chill

To illustrate this, 8-inch cubes were cast from the same melt of iron, poured at the same temperature with the same head and at the same rate. One was cast in the ordinary dry-sand mold, and the other was cast in the same kind of mold lined with 1-inch steel plate. Cooling curves were taken from each block in the manner previously outlined. A comparison of inverse rate

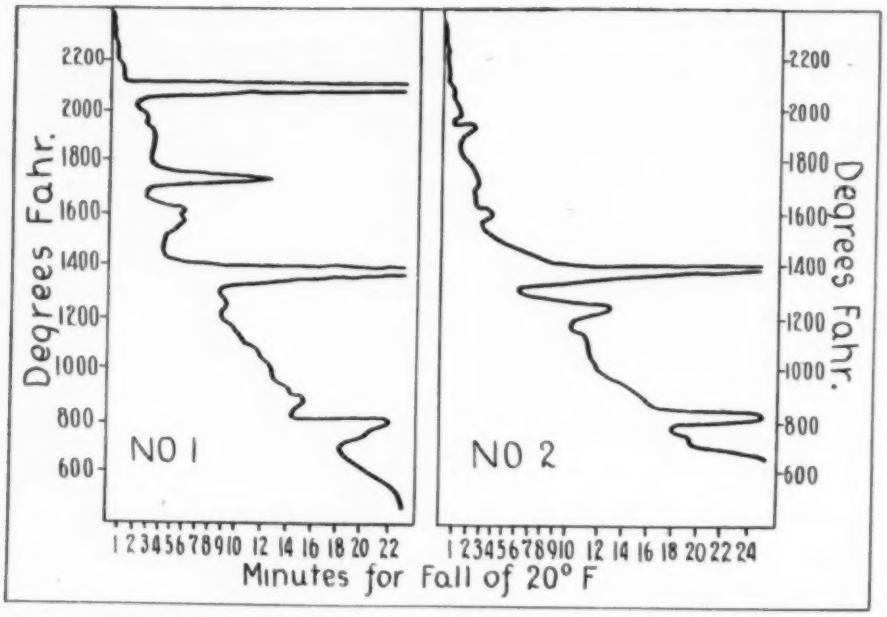


FIG. 3—COOLING CURVES OF 8-INCH CUBES—CURVE 1 TAKEN ON CUBE CAST IN DRY SAND AND CURVE 2 FROM CUBE CAST IN CHILL

curves 1 and 2, Fig. 3, clearly reveals the surfusion of the chill-cast block. The relative quantity of heat evolved during incipient, main, and phosphide eutectoid solidifications are better shown by curves 1 and 2, Fig. 4. The sand-cast block had a large, coarse, weak structure, unsound at the center to an area of 2 inches. The chill-cast block had a fine texture and was remarkably solid throughout.

Show Densening Effect

These tests show the strong grain refining or densening effect of the surfusion phenomenon of cast iron. However, its practical application is not limited to the use of the rigid mold or to iron and steel chills. Surfusion is a physical phenomenon affected by the:

Latent heat of fusion values;
Chemical changes in the molten metal;
Temperature of melting;
Temperature of pouring.

It is to these that the explanation of many of the vagaries of structural variance of cast iron of similar chemical composition and of similar section must be sought. It presents a field of research pregnant with possibilities.

Fletcher, in a recent paper, states that silicon slows down and manganese quickens the rate of solidification. It would be interesting to obtain the composition of the irons used in his investigation. The figures shown in the accompanying table were obtained by the author from two phosphoric irons containing 1.15 and 2.49 per cent silicon, respectively.

These indicate that silicon is not appreciable in its influence on ordinary cast iron, while from an extensive series of cooling curves taken under known conditions, it becomes extremely difficult to give an expression with regard to the true effect of either silicon or manganese on this point. Without systematic investigation under standard conditions, considering each of the elements present, one can scarcely draw conclusions on the subject. Similarly the composite whole involves such a labyrinth of data that it is impossible to formulate any definite statements from our present knowledge.

Ronceray, Brunelli and others have demonstrated the possibilities of slow, or jet, running as a factor in the production of sound castings. The potential value of this as a means to obviate some of the common defects due to mass effect remains undisputed. The principle of slow running is to obtain simultaneous solidification conditions throughout the casting. However, this is a factor strictly limited in its practical application, and ceases to be wholly effective as soon as the rate of running permits the natural volume changes of the molten metal on solidification to operate; that is, as soon as the rate of running exceeds the time taken to solidify. The limitations of this principle in its practical application are only too obvious where mass influence is to be met.

Take, for example, the 8-inch sand-cast cube. The time figures for solidification of this mass of metal are 63 minutes from incipient to main solidification, and 82 minutes from main solidification to the complete solidification of the phosphide eutectoid. This gives a total time from incipient to complete solidification of no less than 2 hours and 25 minutes. From curve 1, Fig. 3, it may be observed that incipient solidification of the silico-ferrite commenced at 2180 degrees Fahr., the main solidification at 2110 degrees Fahr., and the block retained this latter temperature for no less than 44 minutes 32 seconds. The time for the development of the primary crystal grains thus occupied altogether 63 minutes, while the phosphide, remaining molten for a further 82 minutes, afforded ample opportunity for liquidation and segregation.

Adjust Pouring Rate

To pour such a casting slowly enough to eliminate ill effects of the natural volume changes, crystallization and liquidation effects of the solidifying metal without speeding the rate of solidification, thus becomes impossible. However, it amply shows that to take full advantage of the factor of rate of running so far as the manufacture of uniformly solid castings without risers is concerned, it must be considered in conjunction with the time taken during solidification; that is, one must adjust the rate of running by the method of molding, temperature of pouring, and the chemical composition.

To illustrate this in a more practical way in regard to its relation to mass effect, consider the problem of casting in sand a cylinder of iron 8 inches in diameter, 12 inches long, and uniformly solid, with ordinary cylinder iron. On first thoughts, it might be contended that such a cylinder only need be run sufficiently slowly to feed out the draw, or that a sound casting would be obtained by the aid of a 4 to 6-inch head and a feeding rod.

To exemplify this, two cylinders were

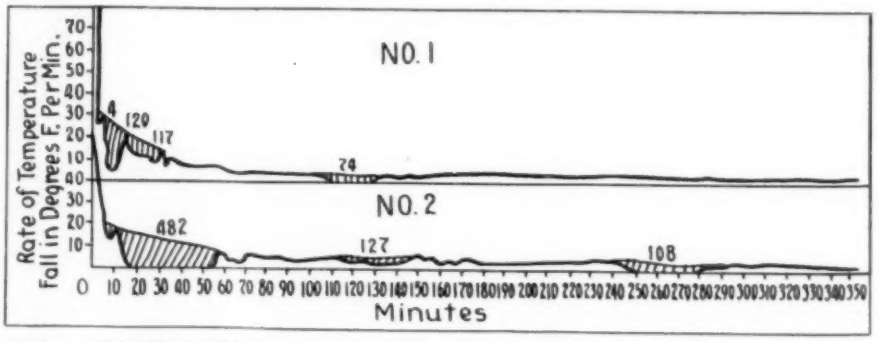


FIG. 4—CURVES SHOWING THE LATENT HEAT EVOLVED ON SOLIDIFICATION OF 8-INCH CUBES, NO. 1 CAST IN CHILL, NO. 2 CAST IN DRY SAND

Effect of Silicon on Rate of Solidification

Total carbon	Silicon	Manganese	Phosphorus	Sulphur	Main solidification Deg. Fahr.	Latent heat of solidification B.t.u.	Latent heat of solidification gram calories	Phosphide eutectoid, deg. Fahr.	Latent heat of solidification B.t.u.	Latent heat of solidification gram calories
3.27	1.15	0.62	1.54	0.086	2057	39	21.7	1755	17	9.5
3.12	2.49	0.52	1.28	0.050	2070	40	22.2	1760	18	10.0

made; the one without any head and running centrally from the top by means of the finest possible jet; the other with 4 inches of head and feeding carefully with a rod. After a series of preliminary experiments, it was found that such a block could, under special conditions be run by means of a jet ¼ inch in diameter, if a large runner basin which has been preheated to 572 degrees Fahr., were used. The mold temperature was controlled at 100 degrees Fahr. The metal was poured with 10 per cent superheat and had the following composition:

	Per Cent
Total carbon	3.21
Silicon	0.60
Sulphur	0.036
Phosphorus	0.77
Manganese	0.62

The condition thus obtained, therefore, were such that, as far as slow running is concerned, the extreme was taken. Incidentally, this experiment offered interesting information regarding the filtering possibilities of small jets.

On being removed from the mold, the casting presented a perfectly smooth and clean skin. It was sound and free from blowholes or other defects. There was no evidence of either piping or sinking, and it would have machined clean on all faces with a light cut. The coarsening of the texture from the outer walls to the center by the slow rate of cooling due to mass was shown clearly. At a position approximately 1/3 the length of the casting centrally from the top, extending about 44 square inches, an internal draw, the enigma and nemesis of cast iron of any dimension, was shown, although the upper 4 inches of the casting was quite sound. On sectioning the block cast with a 4-inch head, which had been fed with hot metal, the same defect was encountered.

This simple illustration suffices to demonstrate the difference between the elementary problem of feeding out the pipe by slow pouring in an ingot of a contracting metal, such as brass or steel, which freeze through a short range of temperature, and the complex problem of preventing drawing of gray iron, a material which expands on solidification and freezes through a wide range of temperature.

Some idea of the length of time the metal remained molten after filling, despite the slow rate of running, is evidenced by the sulphur compounds which rose to the top of the casting, as shown by a sulphur print. Although the sulphur in the iron used was only 0.05 per cent, the upper ¼ inch of the casting was found to contain 0.37 per cent sulphur.

From time to time, the author has had various methods of filtering cast iron submitted to him. The process of these methods never was made clear, but as far as could be gathered, the inventors claimed to remove certain objectionable impurities from the iron and to ensure clean and dense castings. Such devices as strainer cores, jet and slit runners, etc., undeniably justify their adoption. However, these methods always necessitate the use of hot metal, the first essential to clean, sound and dense castings, and safeguard against careless skimming. The metal is not purified by the so-called filtering process. This is a misstatement, calculated to mislead, rather than enlighten, and it is for this reason that reference has been made to it.

Lower Temperature for Welding Urged

To compensate for the lower melting point of cast iron as compared with steel, the Metal & Thermit Corp., New York, recommends that in preheating cast iron sections, preparatory to thermit welding them, these sections be heated only a little more than necessary to show color, such as a dull red heat. If this advice is followed, it is said, a quieter pour will be obtained and the fusion will be just as thorough. This practice has been tried successfully in numerous cases, the most important case being a thermit weld on a large cast-iron press head which required 1100 pounds of thermit. The weld was apparently sound with fusion to the extreme of the edge of the collar, although the cast-iron section was heated only to a dull red heat.

It is believed that this point is important to bear in mind, and that operators will find that it will overcome possible difficulties which they may be experiencing in cast-iron welding. One might suppose that as the cast iron of the parts being welded is not quite so fully expanded at this lower temperature there might, therefore, be a slightly greater tendency for hair line cracks to appear in the thermit steel collar perpendicular to the line of break. In actual practice, however, this has not been found to be the case, probably because of the fact that the expansion curve is much greater up to a red heat than it is from the red heat to the white heat, and that the sections are, therefore, practically fully expanded at this dull red heat.

Centrifugal Casting Is Progressing

A resume of the progress made in centrifugal casting up to the present time by Jesse L. Jones in an address made at a meeting of the Pittsburgh Foundrymen's association. He stated that the centrifugal casting of various metals is quite old, but considerable progress has been made in the past few years. The principal commercial application of the process until recently has been in the casting of large cylinders of considerable length, in nonductile alloys, such as red brass, aluminum alloys, etc. Cylinders 20 feet or more in length and of 2000 pounds in weight, have been made without difficulty. During the war Ford cast the Liberty motor bearings centrifugally. Bearings for diesel engines were cast centrifugally by the Brooklyn navy yard and these same bearings were babbitted centrifugally.

The most important application of this process at the present time is in making cast iron pipe. The use of high temperature molds, the invention of Leon Cammen, New York, has increased the life of the molds used. The sudden heating of a mold from room temperature to 1500 degrees Fahr. or higher, subjects it to enormous stresses and results in checking or cracking of the mold in a short time. Linings of sand or various cements have also proved valuable.

Joins Sand Mixer Firm

C. D. Hollins, formerly sales manager of the Black Products Co., has become vice president and sales manager of the National Engineering Co., Chicago, manufacturer of sand mixing equipment.

Makes Black Heart Malleable

Frenchman Describes the Practice of Producing Malleable Iron in His Country According to Methods Learned in the United States—Meets American Specifications for Tensile Strength and Elongation

BY R. GAILLY

I AM happy that the opportunity is given me to thank the producers of malleable of the United States, because it is due to them that we have been able to build up in our foundry the manufacture of the American malleable iron. President Ramas, and Mr. Remy, who, like myself, had the pleasure of spending some time in the United States, also have been impressed by the hospitable welcome always extended by their American colleagues to the French and Belgian foundrymen. The welcome for these two gentlemen easily is understood, for their competence and high positions make them worthy of it. As far as I am concerned the only title I had was that of being a Frenchman, but over there that is sufficient for all the doors to open before you. The list of those I would like to thank would be too long; however, I wish to make an exception for Professor Touceda, consulting engineer of the American Malleable Castings association, because he is the one who has guided me in my study, and who, in introducing me to his friends, gave me the opportunity to know many American malleable iron foundrymen.

In going to the United States my first aim was to see if American malleable is really much superior to the French malleable, as it was said to be. This part of my study did not require long, because, after my first visit I was able to satisfy myself of this superiority and concluded that it would be of benefit to produce the same metal in France.

What then are the differences between the two malleables? The American malleable permits obtaining in sections of all dimensions, homogeneous metal, as well annealed inside as outside, and easily worked. We have cast pieces 4 inches in diameter, and the metal could be worked easily; whereas with the European malleable it is difficult to anneal thoroughly a piece of more than 4/10 of an inch thick. This comes from the essential difference in the annealing processes. American malleable iron is not decarbonized during the anneal but the combined carbon is changed into free or temper carbon. To anneal European malleable it is necessary to decarbonize the castings, otherwise the metal will not have sufficient strength. For pieces of large section, the decarbonization would have to be continued for hundreds of hours to reach the heart of the metal, and this could only be done by strongly oxidizing the surface.

The American malleable, composed solely of ferrite and graphite, is naturally highly malleable, whereas the presence of pearlite in the European casting considerably reduces its malleability. However, pieces of European malleable, ⅛ to ⅜ inch thick, which can be almost entirely decarbonized, give results comparable to those of American pieces of the same section.

The method which I have adopted to verify the malleability of the metal is the Walker drop test. In this test a weight giving a 70-foot pound blow is dropped repeatedly on a wedge-shaped test piece, curling it up and breaking or cracking it. The test specimen is 6 inches long and 1 inch wide. At the bottom it is ½ inch thick and tapers off to 1/16 inch at the point. The number of blows required to crack or break the test specimen gives a fairly accurate indication of the malleability of the metal. We obtained an average of 4 to 5 blows on cupola metal, a few specimens withstanding 7 or 8 blows. Air furnace iron which we tested usually withstood 15 to 20 blows, certain specimens standing as high as 30 blows without breaking. This test, if it has the fault of not being rigorously accurate at least has the advantage of not requiring an expensive testing machine.

American requirements for the tensile test are a strength of 50,000 pounds per square inch and an elongation of 10 per cent in 2 inches. The test section of the bar is ⅝ inch in diameter and 2½ inches long. We have succeeded in making an iron giving a higher tensile strength and a greater elongation than required by the specifications. The machining tests which we have made confirm the speeds used in the United States. The turnings of this malleable are similar to turnings from steel.

The American malleable is more easily affected by heat than European malleable. For instance, any piece which has been welded must be reannealed, as a hard spot will be formed at the point of welding. Also, the grinding wheels must never be allowed to become dirty, as this would cause unevenness in the surface of the place of contact.

After having verified the qualities of the American malleable I have studied the different processes used in the Unit-

R. GAILLY

Secures Information

MANY American foundrymen who met Mr. Gailly during his visit to this country about a year ago, attending the Rochester convention of the American Foundrymen's association, will be interested to learn of the application he has made of the knowledge of black heart malleable iron which he gained in this country. The American Malleable Castings association has done a great work in raising the standard of malleable iron in United States and it is highly fitting that this association should assist the progressive foundrymen of other countries in producing a better product.

Translated from a paper presented at the International Foundrymen's congress held in Paris, France, Sept. 12 to 15.

ed States. The air furnace is employed in about 90 per cent of the foundries. The triplex process is used in at least two or three large plants, and the open-hearth furnace in two or three shops. The cupola only is used in some foundries for special manufacturing, as for instance for pipe fittings. Its use is prohibited for the manufacture of automobile and agricultural machinery castings. The high carbon in cupola casting produces a metal with low elongation, also it is impossible to avoid a precipitation of primary carbon in the thick sections. The metal being in contact with the fuel becomes laden with impurities, and it is practically impossible to obtain metal of constant analysis during the heat.

The open-hearth furnace is attractive on first consideration, because a greater proportion of the heat produced is used than is used in the air furnace, but it must be operated continuously, which necessitates a large production. It, therefore, is not adaptable to French requirements, at least not at present. The triplex process presents the same hinderance. As regards the electric furnace alone, it only can be used in regions where there are water falls, and even there I doubt whether it would be sufficiently economical; the wear of the electrodes and the refractory brick increasing the melting cost, already burdened by the high cost of electrical power.

Melting in the cupola and partial refining in the converter is not used in the United States, because the converter is a crude instrument. The operation is too rapid to permit control of the additions before tapping. Therefore, it is impossible to obtain comparable results from different heats.

The air furnace process seems to be the only practical one in France, and the two American firms making malleable in France use it. The efficiency of this method is low since only one-tenth of the heat produced is utilized. It also presents the difficulty of considerable wear of the refractory brick. The production cost, therefore, is higher when using the air furnace than when using the cupola.

To melt economically two heats must be made per day, that is, at least 20 tons, as the Americans have progressively abandoned the 5-ton furnace, the standard size being 10 to 15 tons. The advantage of this furnace is that uniform metal can be obtained of the desired composition since additions can be made before tapping, the same as with the electric furnace.

To closely control the metal, a laboratory must be available for the analysis of the iron. The analysis of the hard iron varies in different foundries within the following limits:

	Per cent
Carbon	2.10 to 2.50
Silicon	0.70 to 0.95
Manganese	0.25 to 0.30
Sulphur	0.07 to 0.10
Phosphorus	0.15 to 0.20

These limits are not absolute as one often finds castings having only 0.60 to 0.65 per cent silicon, or 0.20 to 0.25 per cent manganese.

The average loss during melting has been indicated by H. A. Schwartz, manager of research, the National Malleable Castings Co., in his remarkable work, *American Malleable Cast Iron*. This is given as:

	Per cent
Carbon	0.62
Silicon	0.33
Manganese	0.26
Phosphorus	0.00
Iron	1.14
Sulphur—gain	0.01

By these figures it can be seen that the iron to be used must contain high carbon, about 4 to 4.10 per cent. This carbon content, common in the United States, is difficult to obtain in France, but it is secured easily in England, and especially in Sweden. Besides, the latter irons have the advantage of low sulphur. This influences the anneal, but the research on that subject is too recent to enable a clear explanation of this action to be given.

The annealing oven can be heated by different fuels. Oil is little used in the United States, where it is, however, comparatively cheap. Pulverized coal is considered to be an economical fuel when the production of the plant is sufficiently large to warrant the expenditure for the necessary equipment. For smaller production the individual apparatus might be used, but I do not believe that it is in use in the United States.

Coal, fed by hand, is the fuel mostly employed. The coal has a high percentage of volatile matter, 35 to 40 per cent, 5 to 6 per cent ash, and 1 to 2 per cent moisture. Fireclay brick containing 35 to 40 per cent alumina are used. However, any brick which will stand up under a temperature of 1600 degrees Cent. may be suitable.

No oxidizing agent is required in annealing American malleable, but it is necessary to pack the pieces to avoid deformation. For that purpose ore, mill scale, or crushed slag is used. The composition of this packing varies in different foundries, but this is not of great importance.

The annealing temperature varies from 815 to 900 degrees Cent. However, in producing American malleable we have found that it is preferable to anneal at a higher temperature, which varies, according to the composition of the metal, up to about 950 degrees Cent. This is due probably to the higher sulphur contents of our iron. The castings are held at the annealing temperature for 60 to 70 hours, although certain mills anneal a shorter time.

I regret not to have been able to present you a more interesting communication from the technical point of view, but we only have been reproducing in France what exists in the United States and, therefore, have found nothing new. Besides, our research facilities are far from as complete as those of the Americans, who have at their disposal wonderfully equipped laboratories.

High Manganese Causes Chill Cracks

By H. E. Diller

Question—We are making roller castings 54 inches outside diameter, 42 inches inside diameter, and 6 inches deep. These castings are required to be chilled to a depth of 1 inch or more and a large proportion of them have chill cracks. An 1800-pound charge is used in the cupola. The chiller was used cold at first but later was heated with an oil torch just before pouring. Iron was used of the following composition:

	Per cent
Silicon	0.59
Sulphur	0.109
Phosphorus	0.348
Manganese	1.66

Answer—The chill cracks are largely due to the composition of your iron. Iron with 1.66 per cent manganese would have a tendency to cause chill cracks and the manganese should be lowered so that it is between 0.50 per cent to 0.60 per cent in the castings. Also the entire chiller should be warmed before being placed in the mold, so that it is well above the temperature of the sand in the mold.

Will Enlarge Plant

The Coosa Pipe & Foundry Co. of Gadsden, Ala., has acquired a site in North Gadsden and is planning immediate enlargement of the plant at an investment of several thousand dollars, officials of the company have announced. It is the plan of the company to construct some additional units for the plant proper that will materially increase capacity.

Appointed Manager

F. M. Cockrell, formerly promotion manager of the McGraw-Hill Co., New York, has been appointed manager of industrial advertising of the Campbell-Ewald Co., 18 West Thirty-fourth street, in the same city.

Fort Loncin, Liege, Belgium, Which Resisted a 25-hour Bombardment by the German 22-centimeter Guns in 1914 and Held Up the Kaiser's Army for Fourteen Days, Fighting Until an Exploded Magazine Forced Surrender

Americans Complete European Tour

AFTER spending the week ending Sept. 15 at the International Foundrymen's congress in Paris, the American Foundrymen's association delegation concluded its European tour with a trip through eastern France and Belgium. The party left Paris Tuesday afternoon, Sept. 18, and visited Nancy, the Argonne and Verdun battle fronts, Metz, Luxembourg, Liege, Brussels, and Lille. At Nancy and Liege official receptions were tendered by the French and Belgian foundrymen's associations respectively, while the visit to the American owned and operated plant of the International Harvester Co. near Lille on Monday, Sept. 24, formed a fitting climax to a tour which demonstrated throughout its entire course the essential unity of the foundry industry, and its importance internationally in both the economic and political spheres.

It it not too much to say that never before has an American engineering society received such a welcome abroad in so many different countries. Headed by the president and secretary, and supported by prominent past presidents and members of the board of directors, together with representative foundrymen from all sections of the United States and all branches of the American castings industry, the delegation which went to Europe was brought in contact durings its tour with the leaders of industry in Great Britain, France, and Belgium. Relationships were established which will endure for many years, and cannot fail to have a considerable effect on both the commercial and technical development of the foundry business in the United States. At every point on their trip the visitors received suggestions which were replete with interest and value. The careful organization of British foundries to meet the varied requirements of world trade was impressive, as was the care taken in Great Britain with details of castings production such as surface finish and uniformity in physical characteristics. In France, the assembly of representative groups of foundrymen from 12 nations in the congress at Paris was an event of the first magnitude in industrial history. In eastern France and Belgium, the visitors were everywhere struck with the evidence of brisk recovery from war conditions and prosperous business activity. When they finally embarked for home from Cherbourg on the White Star liner HOMERIC, all the members of the party were convinced that they had participated in a great occasion.

This impression was heightened by the events of the last days of the tour which included not only the receptions previously mentioned, but a gorgeous civic welcome at Nancy carried out in the classic style of old Lorraine and a visit to Fort Loncin, Liege, under the personal direction of Col. V. Naessens who was in command when the Germans attacked in August 1914.

Guests of French Foundrymen

On arrival at Nancy, Sept. 18, the American delegation was met by Emile Ramas, president of the Association Technique de Fonderie de France, Charles Masson, vice president of the association with headquarters in the eastern district, and other prominent Lorraine foundrymen. On Wednesday morning, Sept. 19, one of the salt mines for which the Nancy district is famous was visited. At the same time the ladies were taken to points of interest in the city. After lunch a glass works was inspected, following which the civic welcome took place. This was held in the ancient hotel de ville of the town, where the visitors were received by the prefect, M. Magr; the mayor, M. Mengin and two high officers of the French army. A large number of the leading citizens of the district were present. On behalf of the city of Nancy, the mayor presented G. H. Clamer, president of the American Foundrymen's association with a silver medal, commemorating the visit. During this ceremony flags presented to the town by contingents of American troops from Pittsburgh and Philadelphia were displayed.

The principal address of welcome was delivered by Charles Masson, as a representative of the foundrymen of eastern France. He said that the French foundrymen's association originated in Nancy in 1909, at a meeting held during the industrial arts exhibition which took place at that time. The attendance at this original meeting numbered only 95, M. Masson being the chairman. Out of this assembly grew the Association Technique de Fonderie de France, which was helped in its early days by information on methods of organizing received from the American Foundrymen's association. In his response, Mr. Clamer referred to the close ties which have existed between France and the United States for over 140 years, and expressed the wish that the connections recently made between French and American foundrymen would further cement the good relations of the two countries. Addresses also were made by Emile Ramas, president of the French association, and the mayor of Nancy.

Wesnesday, Sept. 19, was employed in a motor tour over the American battle sectors including St. Mihiel, Verdun, the Argonne, Pont-a-Mousson, and Metz. The trip from Metz to Liege was made by rail on the following day, affording the party an opportunity to view the

industrial developments of Luxembourg and the valley of the Meuse in Belgium.

The delegation was greeted at Liege by Joseph Leonard, foundry engineer, Farciennes, Belgium, president of the Association Technique de Fonderie de Liege; Maurice Ledent, foundry proprietor, Herstal near Liege, secretary of the Belgian association; Jacques Varlet, Soc. d' Esperance-Longdoz, Seraing, Belgium; Marcel Remy, malleable foundry proprietor, Herstal near Liege; Eugene Prost, Soc. Belge Griffin, Liege; Ivan Lamoureux, Ateliers Ivan Lamoureux, Liege; Marcel Mikolajczak, Aciers de Marche-les-Dames, near Liege; and several other prominent representatives of the Belgian foundry industry.

Inspect Foundries

On Saturday morning, Sept. 22, the party divided into groups and visited the plants of the Soc. John Cockerill at Seraing; the Soc. Conduities d'Eau; and the Fabrique Nationale. Large loam molding was inspected at the Cockerill foundry, cast-iron pipe manufacture at the Conduites d'Eau, and automobile cylinder and light castings production at the Fabrique Nationale.

Fort Loncin, which was the last to surrender to the Germans in 1914, was visited after lunch. The siege of the fort, which lasted fourteen days, was graphically described by Col Naessens. This fort commanded the railroad from Liege to Brussels and its resistence gave the first serious check to the German rush for Paris. It surrendered on Aug. 15, 1914, after 25 hours bombardment by 22-centimeter guns, and after most of the garrison of 550 men had been killed. At the conclusion of the visit, G. H. Clamer placed a wreath on the tomb of the Belgian soldiers who fell in the defense of the fort. This memorial bears the inscription, "A testimonial from the American Foundrymen's association to the valor of the Belgian army in the Great War."

The visit to Liege was concluded with a banquet tendered the American delegation by the Belgian association at the Continental hotel, on Saturday evening, Sept. 22. Joseph Leonard, president of the Belgian foundrymen, occupied the chair. In his remarks after the dinner he recalled the work of the Commission for Belgian Relief under Herbert Hoover during the war and emphasized the feelings of gratitude toward America which animate the sentiments of the Belgian people. He also emphasized the necessity for close co-operation and exchange of technical information between the foundrymen's organizations of Europe and the United States, in the furtherance of which he pledged the assistance of Belgium.

In his response, Mr. Clamer referred to the industrial importance of Belgium. He said there are 900 foundries in the country, of which 300 can be classed as large shops. The German army, he said, stripped the machinery out of over 1500 Belgian factories, including nearly all her foundries, but in spite of this great handicap, the industries of the country have once more been brought to a high state of prosperity. He also mentioned the debt which nonferrous foundrymen in the United States owe to Belgian engineers for their work on melting furnaces and the application of plaster matchplates to brass foundry work.

"At the conclusion of our tour," Mr. Clamer said, "I want to state that we have been greatly honored by the foundrymen of Great Britain, France, and Belgium, and that we are extremely grateful for the wonderful hospitality which has been showered upon us everywhere we have been. On our journey, we have gained much of interest and profit, but the most important thing of all to us is the opportunity we have had for personal contact with Europe's industrial leaders. We go away feeling sure that we have many friends among the foundrymen of the Old World, with whom we shall never lose touch."

Spoke for Great Britain

H. A. J. Rang, secretary of the Newcastle-on-Tyne branch of the Institute of British Foundrymen, made a few brief remarks on behalf of the British castings industry. He said that the foundrymen of Great Britain are in hearty accord with the movement for greater international co-operation among the producers of castings throughout the world.

Following concluding remarks by Marcel Remy, who referred to his visit to the Rochester convention of the A. F. A. in 1922, the evening was finished with dancing and music. The speeches of the Belgian representatives, which were all in French, were translated into English by Vincent Delport, French correspondent of THE FOUNDRY, Paris. Mr. Delport also translated all the English speeches into French, so that everyone present had a definite idea of the proceedings.

Sunday, Sept. 23, was spent sightseeing in Brussels including witnessing the start of the ill fated international ballon race for the Gordon Bennett cup, On Monday morning the party proceeded to Lille where their long series of official visits and plant inspections was concluded at the French works of the International Harvester Co. of America. This plant, which is one of the four operated by the Harvester company in Europe, was almost completely stripped during the war. It is now operating at full capacity on the same scale as before the war. Complete details of the reconstruction of this plant were published in THE FOUNDRY early in 1920. In a few remarks at the conclusion of the visit, C. E. Hoyt, secretary of the American Foundrymen's association, said that the privilege of looking over an American plant in Europe formed a fitting climax to the remarkable experiences of the delegation in Europe. The successful way in which the plant is being conducted, he said, under the direction of S. G. McAllister, European manager, E. W. Cottrell, works manager, and others, impressed everyone present with the possibilities of manufacturing certain kinds of products in Europe on a quantity production basis under American management. Mr. McAllister and Mr. Cotrell replied for the Harvester company. Champagne and biscuits were served during the tea hour.

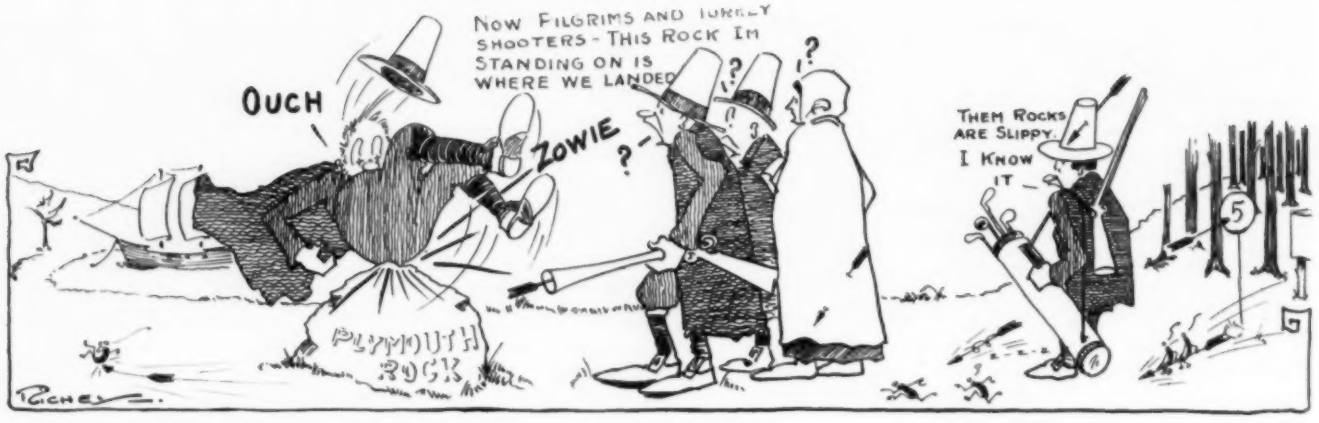
The main body of the delegation returned to Paris on Sept. 25. A number, including President Clamer, V. E. Minich and others left the party in Brussels and Paris for the purpose of visiting other parts of Europe before returning to the United States. The remainder of the party, headed by C. E. Hoyt, boarded the White Star liner HOMERIC at Cherbourg on Wednesday, Sept. 26, and sailed for home. New York was reached on Oct. 3, and the first European tour of the American Foundrymen's association came to an end.

British Promote Research

Progress continues to be made by the British Cast Iron Research association which has its headquarters in Birmingham. The library is rapidly growing, and a catalog just issued gives a most comprehensive list of books covering foundry practice, with a useful selection of works on metallurgy by authors in Europe and America. The official reports of nearly 30 institutes and technical societies are regularly received, with representative publications devoted to iron and steel. The quarterly bulletin, an excellent booklet of over 100 pages, embodies concise summaries of papers of special interest to the foundry industry published in recent years. The work has been skillfully done, attention being concentrated on features and data likely to be of practical service to the foundry manager and worker. The publications demonstrate that the association is more than justifying its existence, and has entered upon a career of great usefulness.

Bill Molds a Bronze Furnace Cooler Casting

BY PAT DWYER



CONSIDERING the manner in which men constantly pop up here and there—11 per cent of the pop based on the idea of public service and the remaining 89 per cent based on the almost universal human desire for a little brief notoriety—considering as I say, this wide-spread popping in connection with the subject of celebrating anniversaries, national, local, social, political, religious, personal and otherwise, I have been somewhat surprised to note that apparently no cognizance has been taken of the fact that last year marked the tercentenary of a most important event in American history.

The story of the manner in which the fabled geni emerged from the Arabian fisherman's bottle and grew and expanded until his head was lost in a rolling pillar of smoke among the clouds, is no more remarkable than the story of how the iron industry of this country has expanded in a few hundred years from a pitiful little infant in the Lynn marshes to the benevolent giant that practically dominates our industrial life.

Iron, king of metals, king in the sense that it is the greatest and most important of all the group of metals melted from ore, marks the year 1922 as the tercentenary of its first appearance in manufactured form in America.

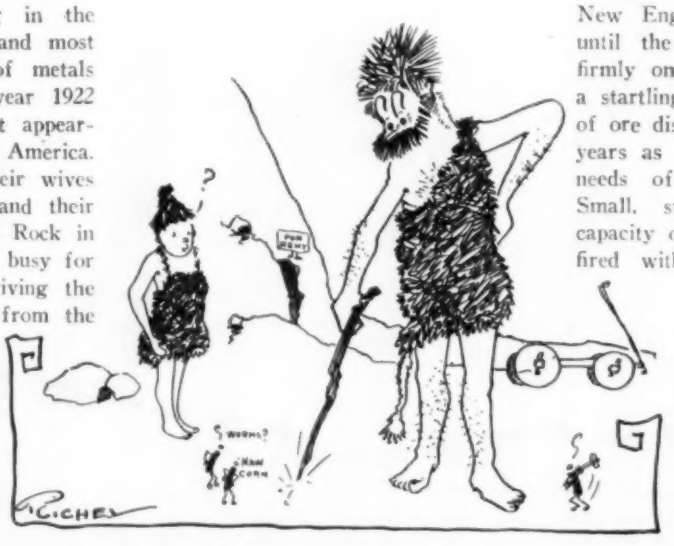
The Pilgrim fathers with their wives and children, their high hats and their iron wills, landed on Plymouth Rock in 1620 and presumably were kept busy for the following two years in driving the wolf literally and figuratively from the door. Discovery of a deposit of bog ore on the site of the present city of Lynn, Mass., confirmed them in their determination—if it is possible that their minds once made up, needed confirmation—to make a home for themselves and their descendants in this new and strange land, filled with wild beasts and still wilder red men and with a winter climate that nipped the ends of their long, austere noses in a manner never experienced in the land from whence they had fled in terror, desolation, wrath and bitterness of spirit.

Iron is the foundation and base, the superstructure and beams that support the roof of modern civilization, the beginning and the end, the alpha and omega of modern business. It is linked up intimately with every form of human endeavor. There is not an article used by man, from the rubber nipple of his infancy, made in an iron mold, to the 6-foot opening in the earth, made with an iron spade to receive his remains, but is dependent either directly or indirectly on the great old master metal.

Almost every ship that plows the trackless waste of the seven seas, every puffing locomotive and every lumbering freight car that is dragged grumbling over the network of steel rails that covers the surface of the earth, is formed either wholly or in part from iron. The loads that are carried from port to port and from city to city, either are made up of iron products or have been fabricated by iron machinery. Food, clothing, transportation, the three great requirements of man are dependent upon iron and have reached their highest state of development in those countries where the manufacture of iron and its products is most prevalent.

Whatever else he does, man must eat and it is not surprising to find that in addition to being the oldest of the industries practised by man, agriculture still is the most important. Conditions have changed radically in the thousands of years that have elapsed since man first by the sweat of his brow, wrung a precarious living out of the inexhaustible bosom of old mother earth. Today the power-driven gang plow, the harvester and the thresher render the feeding of teeming millions a simpler problem than that which confronted our remote ancestors who individually with a pointed stick scrabbled the earth for corn.

The modest deposit of bog ore in New England—soon exhausted, but not until the little colony was established firmly on a self sustaining base—offers a startling contrast to the immense beds of ore discovered and exploited in recent years as the country developed and the needs of the people became greater. Small, stone blast furnaces with a capacity of 3 or 4 tons of iron a day, fired with charcoal and operating on blast supplied by over-shot water wheels, have given place to great roaring giants driven to capacity by powerful pumping engines. Burly brutes, these modern furnaces eating up 1200 to 2000 tons of iron ore in 24 hours and discharging a molten torrent of iron equivalent to between 600 and 1000 tons in a corresponding period.



ORIGIN OF CORN PONE, CORN MEAL, CORN LIQUOR CORNUCOPIAS AND JUST CORNS

Fairly extensive deposits of iron ore in Virginia, Pennsylvania, Ohio, New York, Tennessee and Alabama exerted a powerful influence in the industrial development of these commonwealths, but it was not until the great Mesabi iron range in Minnesota was opened up in 1859 that the iron industry in the United States properly struck its stride.

An army of steam shovels sink their powerful jaws in the face of the iron ranges and scoop ore to the extent of 50,000,000 tons a year. For the present year it is estimated that the production will reach the 60,000,000 mark or even more. A few million tons one way or another is not considered a factor of startling importance. A fleet of giant carriers conveys the ore to the great unloading docks of Cleveland, Conneaut, Buffalo and other cities along the Great Lakes from whence it is railroaded to the hungry blast furnaces. Ore from other sources is smelted in addition and in sufficient quantity to raise the total yearly pig iron production of the country to over 40,000,000 tons, which if you care to figure it out is equivalent to nearly half a ton for every man, woman and child within the country's borders.

The claim of many a king is based on flimsier foundation than the record of the master metal.

Sitting out on the old front porch with Bill the other night the conversation kind of lingered along by fits and starts and probably would have died altogether if I had not innocently referred to a statement I had read some place recently touching on this same pig iron production. Bill made no comment until I introduced the half ton to every man, woman and child phrase. He held up one hand after the manner of these gentlemen in blue at city street intersections who invariably allow every machine to pass except yours.

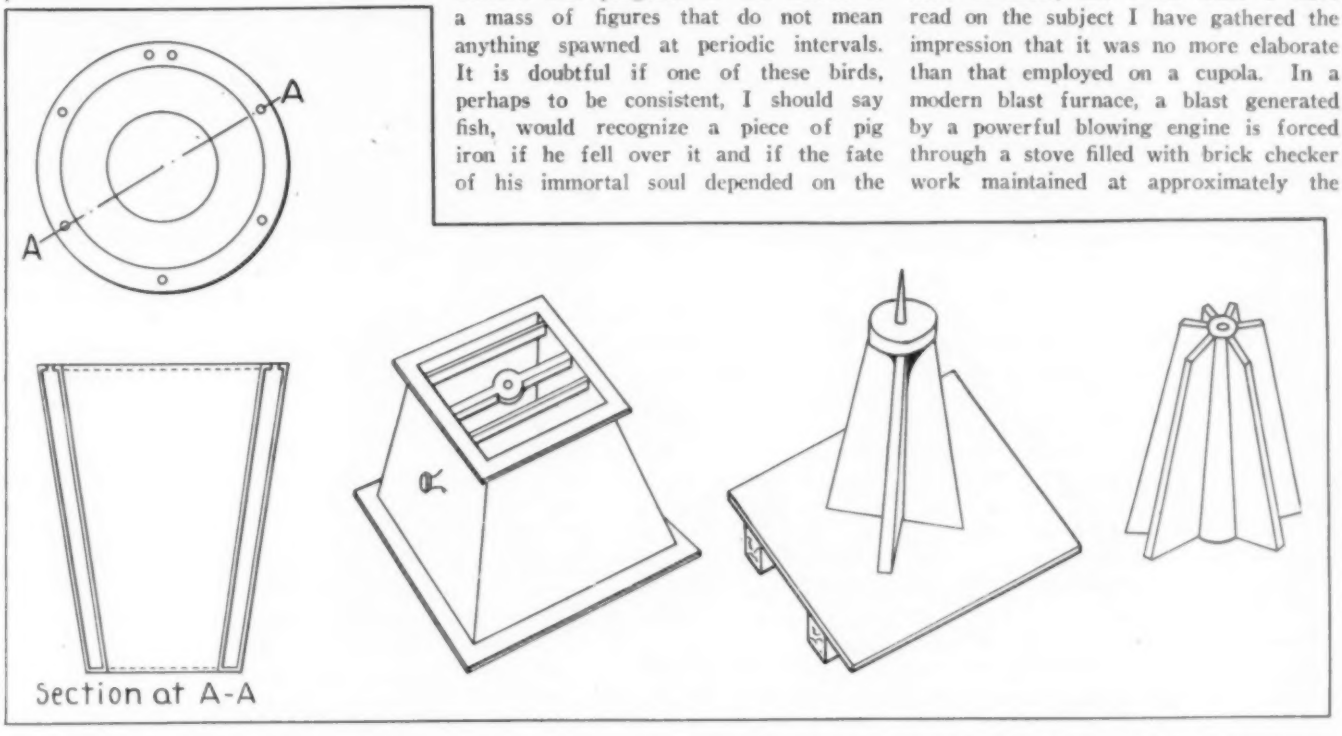
"Stop!" says brave Bill. "Stop right there me lad. I am tired of hearing this everlasting argument based on the man, woman and child. It is a favorite weapon in the hands of statisticians and others whose sole contribution to the welfare and progress of the nation is a mass of figures that do not mean anything spawned at periodic intervals. It is doubtful if one of these birds, perhaps to be consistent, I should say fish, would recognize a piece of pig iron if he fell over it and if the fate of his immortal soul depended on the accuracy of his answer, he could not say off-hand if pig iron is a product of a blast furnace or a rolling mill.

"Perhaps it is raised on a farm and the crop garnered in the fall like potatoes or peanuts. I should not be at all surprised one of these fine days to read that because potatoes, peanuts and pig iron form an alliterative group they should be considered in the same class with, perhaps, prunes, pine cones and Pitcher's castoria thrown in for good measure. It is said there is luck in odd numbers and if the blessed day ever arrives when the aforesaid list is adopted, I shall consider it a privilege and a pleasure to add one more word to the list and that word is nothing more or less than our good old standby and mutual friend, piffle.

"However, tilting at windmills never will buy a pair of shoes for the baby. I am willing to admit that blast furnaces are wonderful devices, but as a foundryman I am more interested in the almost innumerable castings that enter into the various component parts of the stack and auxiliary equipment, than I am in the operation of the furnace itself. A pair of nice, healthy blast furnaces, sound in wind and limb and with their digestive apparatus in good working order will require more steel, iron and brass castings in the run of a year than are made in many a jobbing foundry in the same period of time.

"I don't know what kind of rigging the old time iron masters provided for conducting the cold blast into their little furnaces, but from what I have read on the subject I have gathered the impression that it was no more elaborate than that employed on a cupola. In a modern blast furnace, a blast generated by a powerful blowing engine is forced through a stove filled with brick checker work maintained at approximately the same temperature as the interior of a volcano. This red hot blast is driven at high pressure through the blow pipes into the furnace and as a result the water cooling system has developed into an important factor. Many of the castings involved present interesting problems from a foundry viewpoint. The methods adopted for making some of the principal castings vary to some extent in different foundries, depending on local conditions which also includes the experience and inventive faculty of the man responsible for outlining the method and designing the rigging.

"The large bronze cooler which protects the inner end of the blow pipe and copper tuyere is fairly typical of the castings I have in mind. I saw them made contsantly at the rate of one a day for several years, and since the only castings lost in that time could be counted on the fingers of one hand, I think the method and rigging employed worthy



TOP AND SECTIONAL VIEWS OF CASTING TOGETHER WITH PERSPECTIVE VIEW OF DRAG FLASK, FOLLOW BOARD AND CORE ARBOR FOR THE BRONZE COOLER

of comment. These castings are made in various sizes depending on the size and capacity of the blast furnace, but in this particular instance the casting was 30 inches high, 24 inches diameter at the outer end, 18 inches diameter at the nozzle end, had a uniform metal thickness of ¼ inch and weighed 400 pounds.

"The mold was made in dry sand and the rigging provided included two iron flasks, one wood pattern, one iron corebox, besides the incidental bolts, clamps, vent and core rods. The two flasks were required to enable a man to pour a casting every day. He assembled one mold and poured it and rammed a second mold and placed it in the oven. By having the two molds on the floor in the early part of the day, he lost no time while waiting for a crane, but alternated between one and the other until both were finished. Of course, occasionally he was hung up waiting for a lift, but that happens in the best regulated foundries at times and is regarded as part of the day's work.

"The follow board was provided with an elevated cross that accurately centered the pattern. The upper part projected through the pattern and served as a core print. A spike on the top entered a guide hole in a cross bar in the drag and centered the flask in relation to the pattern. The same guide hole later served to locate the pointed end of the long rod supporting the center core arbor.

"Several shallow bars in the bottom of the drag, instead of the usual bottom plate, served to retain the sand in the flask while in transit between the molding floor and the oven.

"In the morning the molder placed his follow board on the floor in an approximately level position and set his pattern. The drag then was lowered over the pattern and rammed full of riddled heap sand containing a small portion of heap sand and a few handfuls of flour. The sand was quite open and the binder was held to a minimum to insure permeability. The follow board was clamped to the flange of the drag flask and after the mold was rolled over the follow board was removed and a flat parting made around the edge of the pattern. The arbor was clay washed and after a long bolt, threaded at one end and provided with a washer at the other end, was pushed through a hole in the center, it was lowered into the pattern. A coarse, open new sand, bonded with flour in the proportion of one flour to 15 sand was rammed in the spaces between the wings of the arbor and the pattern. A column of fine coke was rammed between each pair of wings at the point where they joined the hub of the arbor. This pat- caution was observed to insure a free escape of the gas generated from the core when it was surrounded later by the molten metal. It also assisted in the drying process while the mold and core were in the oven.

"The shallow cope then was set on and rammed full of sand. The long bolt extended through the arbor and projected above the cope where the end was secured by a nut and suitable washers. Then the cope with core suspended was lifted off, placed on two high horses where it was finished and blacked. No runners were placed in the cope at this time. The sand was cut away between the bars in a ring corresponding to the shape of the top of the pattern for a purpose to be explained later. After the pattern was drawn out of the drag and the mold was finished and blacked, the cope was returned to place with a brick under each corner to keep the upper and lower halves of the mold apart and to facilitate drying the mold in the oven. The entire mold was placed in the oven and left there over night. On the following day it was placed back on the floor once more, cored, closed and poured.

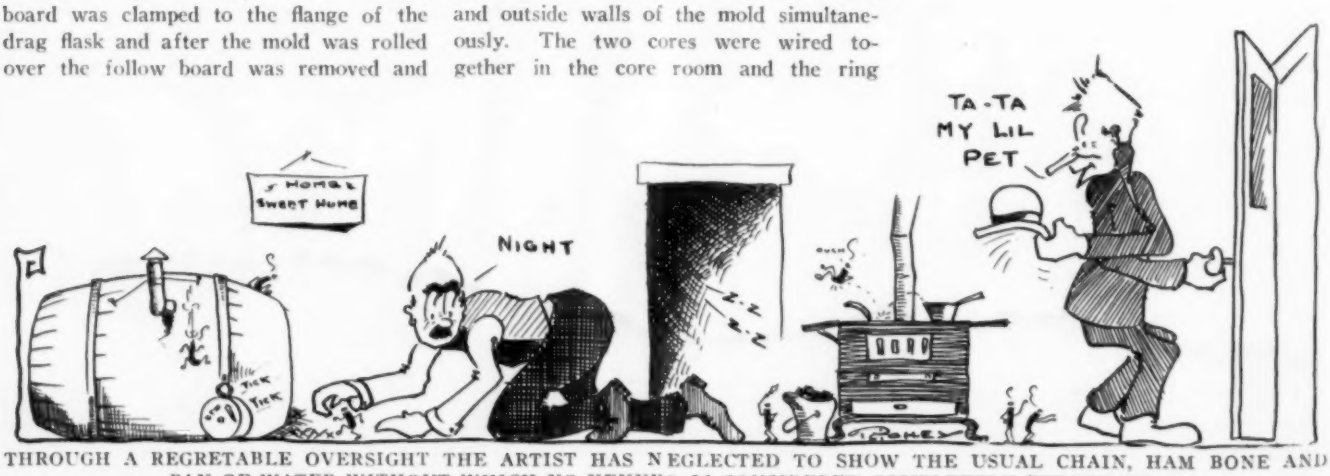
"The water-chamber core was made up of two parts, the chamber core proper and a ring or cover core provided with openings for the pipe connections, vents and 12 small gates ½ inch x ¼ inch staggered in such a manner that the metal was directed down both sides of the chamber core and filled the inside and outside walls of the mold simultaneously. The two cores were wired together in the core room and the ring core was provided with suitable hooks by which to suspend it from the cope.

"Four flat pieces of wood ¼ inch thick were laid on the bottom of the mold and four long strips the same thickness, spaced equidistantly, were placed upright against the wall of the drag. The chamber core then was lowered into place and the cope was closed on the drag. Small wood wedges were driven between the top of the core and the under surface of the exposed bars. Suitable hooks were inserted in the loops in the core and screwed up tight. Runner sticks and vent pipes were placed in their respective openings in the ring core and then the open space between the bars was rammed full of green sand, thus insuring an efficient seal against the entry of any metal into the vents. A circular basin was built on top of the cope and after the runner sticks were withdrawn, the cope with both the center core and the chamber core rigidly suspended, was lifted off temporarily until the thickness strips were removed from the drag. The cope then was replaced for the last time, and after it was clamped in place the metal was poured into the mold.

"The core represented one of the most interesting features of the job."

"Put away the tools," I said. "Put them away. If you start making a core at this time of night you won't get it into the stove before midnight and I am no night owl."

"Well," said Bill. "I'll tell you. It is possible you might not be interested in the description of the core, but I also intended to tell you a few items about the bandy legged bird who made it. However, since you seem so anxious to retire, perhaps I had better not say anything that might cause you to kick the end and maybe a few slats out of your barrel during the night. Show me your clock, I'll punch it and call it a day!"



THROUGH A REGRETABLE OVERSIGHT THE ARTIST HAS NEGLECTED TO SHOW THE USUAL CHAIN, HAM BONE AND PAN OF WATER WITHOUT WHICH NO KENNEL IS CONSIDERED COMPLETELY FURNISHED

CONTRACTION OF LIGHT ALUMINUM ALLOYS

By Robert J. Anderson

Contraction in Chill Molds

Effect of Copper—Copper in increasing amounts up to 12 per cent lowers the contraction of aluminum from 1.68 to 1.19 per cent. The following table shows the effect of increasing copper on the contraction.

Linear contraction of binary aluminum-copper alloys; mean contraction when poured at 700 to 800 degrees Cent. in graphite molds.

Alloy Number	Nominal Composition	Inch per foot	Linear Contraction Pattern-makers' Scale	Per cent
1	100 Al	0.198	1/60	1.65
2	96:4 Al-Cu	0.163	1/73	1.36
3	92:8 Al-Cu	0.161	1/74	1.34
4	90:10 Al-Cu	0.149	1/80	1.24
5	88:12 Al-Cu	0.143	1/83	1.19
6	86:14 Al-Cu	0.144	1/82	1.20

Effects of Iron—Iron decreases the contraction of aluminum and aluminum-copper alloys, and in foundry practice cracking in the molds on casting the ordinary 92:8 aluminum-copper alloy often can be overcome by increasing the iron to 1.0 or 1.5 per cent. Iron to the amount of 4 per cent when added to the 92:8 aluminum-copper alloy causes the alloy to become viscous and increases the melting point, and renders the alloy viscous and increases the

From a paper presented at the Cleveland convention of the American Foundrymen's association, May, 1923. The author is metallurgist, nonferrous metals section, United States bureau of mines, Pittsburgh.

(*Continued on Data Sheet No.* 498)

CONTRACTION OF LIGHT ALUMINUM ALLOYS

(*Continued from Data Sheet No.* 497)

melting point, and renders the alloy difficult to cast. The following table shows the effect of increasing iron on the contraction of the 92:8 aluminum-copper alloy.

Linear contraction of aluminum-copper-iron alloys; mean contraction when poured at 700 to 800 degrees Cent. in graphite molds.

Alloy Number	Nominal Composition	Inch per foot	Linear Contraction Pattern-makers' Scale	Per cent
3	92:8 Al-Cu	0.161	1/74	1.34
17	90:8:2 Al-Cu-Fe	0.155	1/77	1.29
18	88:8:4 Al-Cu-Fe*	0.145	1/82	1.21

*In the pouring-temperature range 900 to 950 degrees Cent.

Effect of Magnesium—Magnesium has a pronounced effect in lessening the contraction of aluminum and its alloys, as may be seen from the following table. Magnesium markedly lowers the contraction of aluminum-copper alloys, and its effect is much stronger than that of iron. Cracking in the 92:8 aluminum-copper alloy may be overcome often by the addition of 0.5 per cent magnesium.

Linear contraction of magnesium containing aluminum alloys; mean contraction when poured at 700 to 800 degrees Cent. in graphite molds.

Alloy Number	Nominal Composition	Inch per foot	Linear Contraction Pattern-makers' Scale	Per cent
1	100 Al	0.198	1/60	1.65
7	96:4 Al-Mg	0.166	1/71	1.38
8	92:8 Al-Mg	0.138	1/86	1.15
3	92:8 Al-Cu	0.161	1/74	1.34
19	91.5:8:0.5 Al-Cu-Mg	0.152	1/78	1.27
20	90:8:2 Al-Cu-Mg	0.130	1/92	1.08

(*Continued on Data Sheet No.* 499)

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

THE FOUNDRY DATA SHEET, OCT. 15, 1923
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

H. D. HARVEY, OWNER AND TREASURER

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BALTIMORE, MD., U. S. A. April 20, 1923.

The Foundry,
Cleveland, Ohio.

Att. of Mr. G. B. Howarth.

Dear Sir:-

We have just received a letter from Buenos Aires in regard to inquiry on melting Furnaces, and referring to our advertisement in "The Foundry" of August 1909, page 27. We consider that this is remarkable on account of time elapsing, a period of 14 years; and we are in hopes that it will lead to some very attractive business.

Yours truly,

THE MONARCH ENGINEERING & MFG. CO.

By

Green Sand Cores in Bushings

Intimate Details Are Presented Covering Molding, Gating and Pouring These Castings Together with Relative Merits of Green and Dry Sand Cores Under Varying Circumstances

BY CHARLES VICKERS

MOLDS for some cylindrical bronze castings are made in green sand with dry sand cores to fill the central space; patterns for others leave their own cores, that is, no dried cores enter into the composition of the molds. In former articles examples have been cited of bushings molded both horizontally and vertically where dry sand cores have been employed. Obviously a dried core eliminates considerable work on the part of the molder by transferring it to his brother workman, the coremaker. Also, with a dried core a casting may be poured in a position that would be impossible where a green sand core is employed. Whether the green sand core is the cheaper or not will depend entirely on the shape of the pattern. If it is a simple ring shape, probably a green sand core will be the cheapest, but where molding the casting in a vertical position involves complicated operations, the green sand core is not an economy although the pattern may leave its own core.

The green sand core involves a little more work in ramming the mold because the core has to be rammed and vented, but in contrast, a dry sand core has to be set properly in its prints and in the majority of cases precautions involving additional work have to be taken to prevent the liquid metal from entering the core vents. The vents must be extended to clear the outside of the mold. So far as the actual molding is concerned neither type of core presents any particularly superior feature that would justify its use under any and all circumstances.

A dry sand core involves the services of a coremaker, the cost of the sand, the binder and the fuel for the oven. Therefore, where the circumstances seem to warrant the use of a green sand core as in the bushings illustrated in Fig. 1 it should be adopted since it will reduce the cost of the casting. However, it is well to bear in mind some of the undesirable features. While the expense of coremaker, sand, binder and fuel is eliminated, casting losses are higher as green sand cores are subject to scabs, cuts, and blows on little provocation. Small, thin castings never may be a source of trouble when made with a green sand core, but heavier castings will prove unsatisfactory unless the

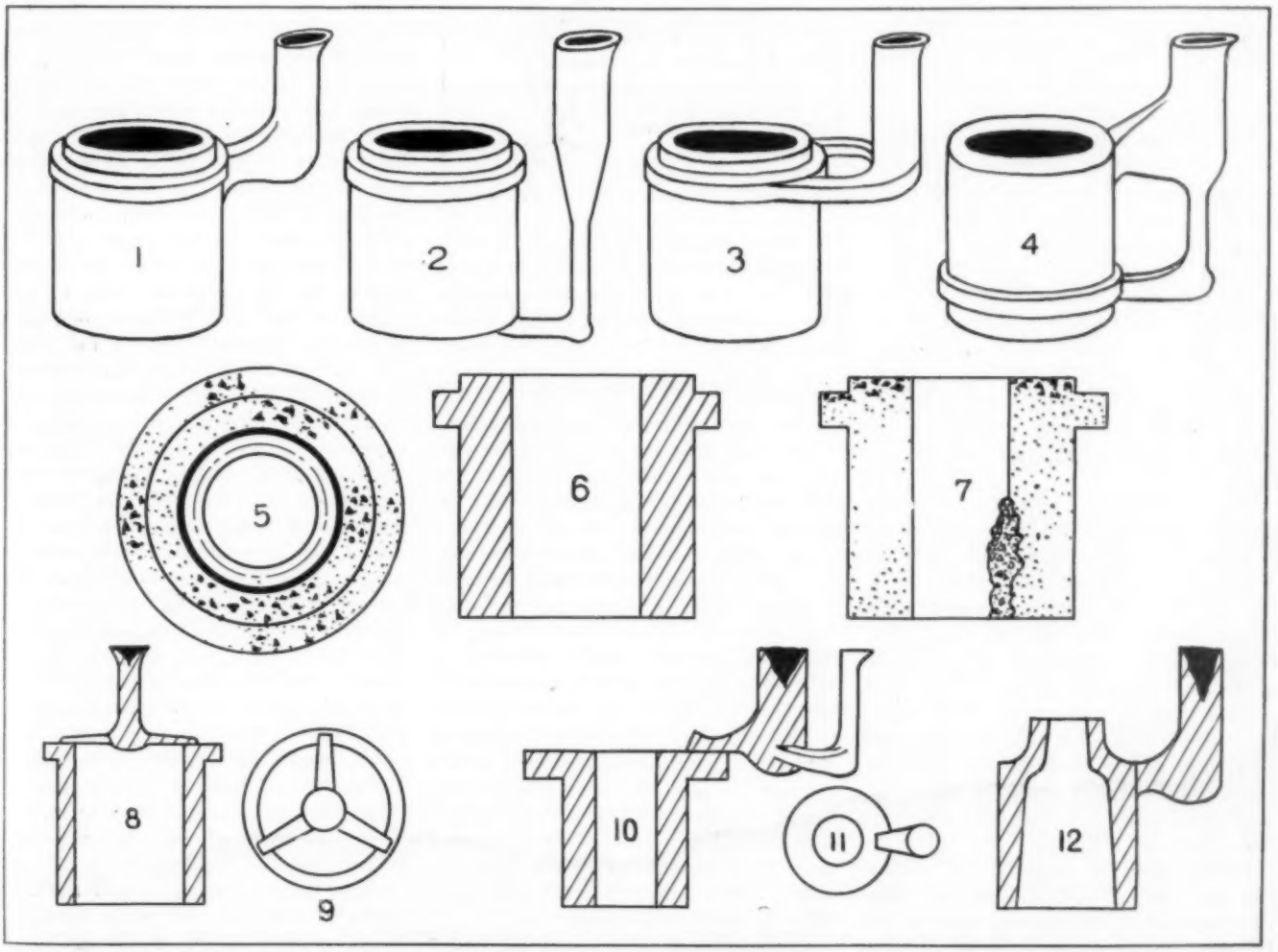


FIG. 1—DIFFERENT METHODS BY WHICH GATES SHOULD AND SHOULD NOT BE ATTACHED—EXAMPLES OF SCRAP CASTINGS DUE TO IMPROPER GATING ARE SHOWN AT 5 AND 7

sand is suitable. Thus it would not be advisable to attempt to make the castings 1, 2, 3 and 4 Fig. 1 in a No. 0 or finer sand, because no matter how carefully the molder rams or vents the sand the core will scab when the metal impinges on it. A large patch of sand will be gouged out of the core where the first metal hits it and if the casting subsequently is split open it will appear as shown at 7 Fig. 1 and the top will be full of sand holes as indicated at 5.

Open Sand Needed

The casting marked 7 in Fig. 1 was gated at the bottom in the style shown at 4 or 2 and the cutting or scabbing was entirely due to the inferior quality of the sand. It was not sufficiently permeable to gas and in addition was lacking in heat resisting bond. What is needed in cases of this kind is a free venting sand, rather coarse, for exampie a No. 2 or 3 of any recognized good grade, with a good strong bond. Some sands when compressed in the hand act as though a sticky substance is present. Usually these sands are colored a deep brown and probably carry a considerable percentage of iron hydroxide. Other sands lack this sticky feature and usually present a pale yellow appearance.

The grade of sand first mentioned is the most suitable to use where a chunky pattern is designed to leave its own core. It is not necessary to dry the molds for castings of this character, either on the surface or completely. All that is necessary is to supply a proper grade of molding sand and keep it in proper condition. These castings are made regularly without any trouble until the sand becomes burned out or until a change in the new sand ushers in a period of adversity. Spirit chastening experiences along this line usually occur in the winter season when difficulty experienced in procuring new sand from the frozen bank in and out house, results in allowing the sand piles in the shop to deteriorate.

Where a supply of suitable molding sand is available, no valid reason exists to prevent gating bushings of the type indicated in the manner shown at 1 Fig. 1. This is the easiest and most logical method for making the mold. Clean, sound castings will be produced if the sand is rammed evenly and to a normal density. For purpose of comparison the following may be regarded as typical of the methods and material employed in making molds for castings conforming in a general manner to that shown at 1 Fig. 1.

Facing sand is prepared by mixing two parts of old sand and one part new sand with a shovel and then passing the mixture through a No. 8 riddle. Where a follow board is provided the pattern is set in place with the flange resting on the board. If no follow board is available the pattern is placed in the same position on a flat board. A wood strip the same thickness as the part of the pattern above the flange, is placed under two opposte sides of the flask. When the drag is rolled over the strips are removed and the sand joint is made flush with the upper side of the pattern flange and also flush with the face of the flask. The part of the pattern above the flange will be molded in the cope.

Where the pattern is strong and rigid the core may be rammed first and the added weight will help to steady the pattern. The core is rammed by throwing successive handfuls of screened sand

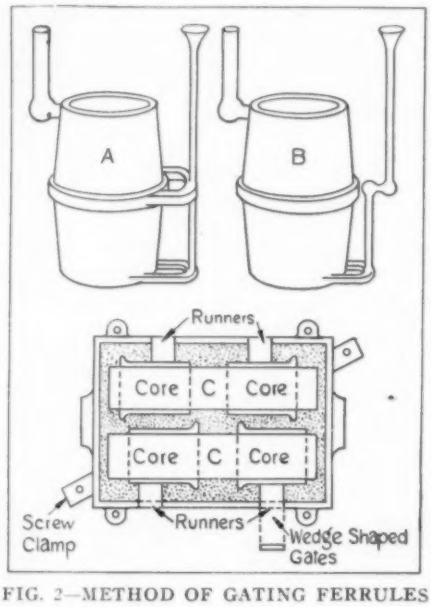


FIG. 2—METHOD OF GATING FERRULES

into the pattern. The force with which the sand is thrown is gaged nicely to pack the sand to the proper density. This is a form of knowledge which only can be gained through actual experience.

Ramming the Mold

After the core is rammed, facing sand is banked around the outside of the pattern and the remaining space in the flask is filled with heap sand. While using the peen rammer care is exercised to see that it does not approach the pattern closely enough to dislodge the layer of facing sand. If necessary the drag may be built up by the addition of frames or deepeners until a thickness of about 3 inches of sand is assured over the pattern. On a deep pattern it may be necessary to ram several courses of sand and on each occasion a layer of facing sand is applied to the pattern before the heap sand is shoveled into the flask. The final course of sand is butted until it is packed so firmly that the fingers pressed down firmly will only make a slight impression.

The surplus sand is struck off and a sufficient quantity of loose sand scattered over the surface to form a bed for the bottom board. The bottom board is placed on the prepared surface, pressed down hard and given a little twist at the same time. For added security it is customary for the molder to tap the center of the board with his rammer. If the board merely is rubbed back and forth, the sand may assume a rounded form and as a result will not be in intimate contact with the board at all points when the mold is rolled over. Should one of these unsupported points appear under a casting the weight and pressure of the metal will force the sand down and produce a lump on the casting. In extreme cases the metal will burst through the sand and another casting will be added to the scrap list.

In the next succeeding step the drag is rolled over and the parting made on the joint. The cope part of the flask should be deep enough to provide at least two inches of sand over the top of the pattern. If the flask in the original shape is not high enough it may be built up with a frame or deepener in the same manner as the drag was treated under similar circumstances. After the sprue stick is set in place the cope is filled with sand, rammed and lifted off.

Size of Sprue

The most suitable style of runner is a combination of 1-inch diameter sprue and 2-inch diameter riser. The riser is set about one inch from the side of the flange and is connected to the sprue by a gate about one inch wide and the same depth where it joins the sprue and about half the size where it joins the riser. On castings of the same general character as those shown in the upper row Fig. 1, a single tap is cut into the flange. Where the flange is too thin to take a gate of this kind, the gate sometimes is cut the full thickness of the flange and then continued a little deeper on the body of the casting. Where conditions force the adoption of this style gate, the casting is allowed to remain in the sand until it is cold. If any attempt is made to remove the gate while the metal is hot it will break a piece out of the flange. In some instances this awkward gate may be discarded in favor of that shown in 2 and 4 Fig. 1, although it involves more work in making the mold. The gate shown at 3 is not recommended for medium weight or heavy castings, but it serves satisfactorily on light, thin castings.

The upper part of the sprue should be made considerably larger than the bottom to serve as a basin that may be filled with metal all the while the metal is entering the mold. The small connection between the gate and the riser helps to maintain the same condition. Some molders prefer a curved to a straight connecting channel between the base of the sprue and the base of the

riser on the supposition that where the metal enters the base of the riser on a tangent it will assume a rotary motion that will collect any dirt and float it up the riser.

The green sand core may be vented before the pattern is drawn by shoving a sprue cutter down through the center. A corresponding hole is punched through the cope. Where conditions are favorable the sprue cutter may be shoved down through both cope and core before the cope is lifted. This type of vent will remove all gas and steam generated during the pouring process.

Various Gates

The bushing shown in various positions in the two upper rows Fig. 1, is a crank pin bushing used on solid end type locomotive side rods. Apparently it is a simple casting and usually no trouble is experienced when it is molded in suitable green sand. It may be gated in the manner shown at 1 or 3 Fig. 1. Castings shrunken slightly on top are liable to result when method 2 is employed and castings shrunken to a less degree are produced when the gate shown at 3 is used. Where the sand is too close or lacks fire resisting qualities the method shown at 4 may be adopted. This method involves the use of a three-part mold with the accompanying waste of time and should not be necessary on a casting this shape and size.

If no other than fine sand is available it is advisable to prepare a quantity of facing sand from a mixture of half new and half old sand with one part of flour added to each 20 parts sand. If the casting does not come clean as shown in section 6, Fig. 1, it is apparent that something is wrong. The metal may have been poured too cold. This feature may be checked by observing the manner in which it flows through the runner. If metal flows freely through the small sprue described in a former paragraph, it may be accepted as evidence to prove that the temperature is not too low. Attention should be focussed upon the sand, the molding method and the manner in which the sand is rammed and vented.

A pattern designed to leave its own green sand core is molded in a vertical position and may be gated in the manner illustrated in the top row Fig. 1 where the casting is heavy or as illustrated in 8 and 9 where the casting is thin. The ferrule castings shown at 8 is shaved as thin as possible and yet it runs quite freely. A brass pattern designed to leave its own core and the type of gate shown at 9 usually are employed on this job.

Where these castings are molded by hand the gate is attached firmly to the pattern and serves as a convenient place to locate the rapping and draw spike hole. However, these castings usually are molded in large quantities, competition is keen, prices obtained are ruinous to those not properly equipped and, therefore, hand molding no longer is practiced to any extent. Ferrules have been molded horizontally with dry sand cores in the manner shown at *C* Fig. 2, where two patterns are shown mounted on one long core print. Special flasks were provided with runner openings in the long sides and usually two complete patterns, or the equivalent of four castings, were molded at one time. The mold was made in the usual manner, but after it was closed it was set up on edge, clamped and poured in that position. The brass molders screw clamp was applied as shown in the illustration. The two runners on one side of the flask were poured first by a pouring gang which traveled from one end of the row of flasks to the other end. The first molds poured were rolled back by two men on either side who kept pace with the men handling the ladle. When one side of all the flasks were poured, the pourers retraced their steps and commenced to pour the other side.

The dry sand core was used extensively in making ferrules before aluminum was introduced in yellow brass practice. Exceedingly hot metal was required to pour the castings and a large percentage of the castings either were misrun or cold-shut where green sand cores were employed.

A minimum of 2 ounces of aluminum added to 100 pounds of yellow brass high in zinc and well leaded will ensure a degree of fluidity that renders the process of making ferrules with green sand cores comparatively easy. This mixture also has the advantage of producing smoother castings than where no aluminum is added. Cheap scrap with a generous percentage of emery grindings and washed metal is used where the aluminum is omitted. In fact in some shops ferrules may be compared to scavengers, since they are poured with the left overs. Anything and everything fit for nothing else is poured into ferrules.

Poured on Top

Ferrules molded on end with green sand cores are gated on top as shown in 8 and 9 Fig. 1. From the sprue the metal is diverted into three channels and drops straight down between the inner and outer wall of the mold. If the metal is melted in a tilting crucible furnace the metal may be carried to the molds in small hand ladles similar to those employed to pour snap flask molds in an iron foundry. An individual sprue is provided for each mold in the flask. It is flared at the top and the metal is poured in one quick flop. Loose iron rings or partial rings about one inch high placed around the openings prevent any splashed metal from entering the other runners in the cope. Considerable experience is required on the part of the operator before he can pour a flask full of perfect castings.

An approved method of gating a bushing with a flat top flange is shown in 10 and 11 Fig. 1, where 10 is a section and 11 a plan view of both gate and casting. A gate cut into the edge of the flange would have a tendency to draw in the angle formed by the flange with the body, particularly if the flange is wide compared with the body. Casting of this general shape made vertically with green sand cores, and with the flange on the upper end usually are satisfactory when gated in the manner shown. The most important point in connection with securing good brass castings and one that cannot be stressed too strongly or too often is the necessity of providing suitable sand.

A type of casting sometimes made with a green sand core is shown at 12 Fig. 1. Obviously on account of the narrow top molded in the cope the castings cannot be gated in the manner shown at 10 and 11. The style of gate shown at 12 will serve satisfactorily. The core should be well vented and the part forming the shoulder should be made from a mixture of half new and half old sand strengthened by the addition of one part of flour to 20 parts sand.

Difficult Shape

Another type bushing frequently designed to leave its own core is illustrated at *A* and *B* Fig. 2. It really is more of a liner than a bushing and on account of the small flange encircling the pattern on the horizontal center line the molding process is slow. The mold has to be rammed while the pattern is set in a vertical position and three partings will be required, one at the bottom, one at the center flange and one at the top of the pattern.

The pattern itself represents a comparatively long and difficult job on the part of the patternmaker. It is built up from wood segments glued and nailed in courses and with the joints broken in the manner customary with brick work. The metal thickness at the top rarely exceeds ½ inch and naturally this prevents the patternmaker from allowing anything but a nominal taper on the inside to clear the core in drawing the pattern. The mold may be gated as shown at *B* Fig. 2 entirely at the bottom; or, as at *A* where an additional gate is cut at the center flange. Usually a small riser is provided on the top at a point diagonally opposite the runner.

The molding sand should be similar

to that suggested for the crank pin bushing. If the mold is made in fine sand it will be necessary to spray the face with molasses water and skin dry it before pouring the metal. This precaution may be omitted where a suitable grade of sand is employed and the mold may be poured while it is still green. Castings of this character over 12 inches diameter should not be poured from a single runner. In all probability the metal will show a porous structure on the side opposite the gates. The greatest care must be observed to ram the sand to a uniform density both inside and outside the pattern. Concealed soft spots in the mold will be reflected in the shape of lumps on the casting. This feature usually is sufficient to condemn the casting on account of the increased

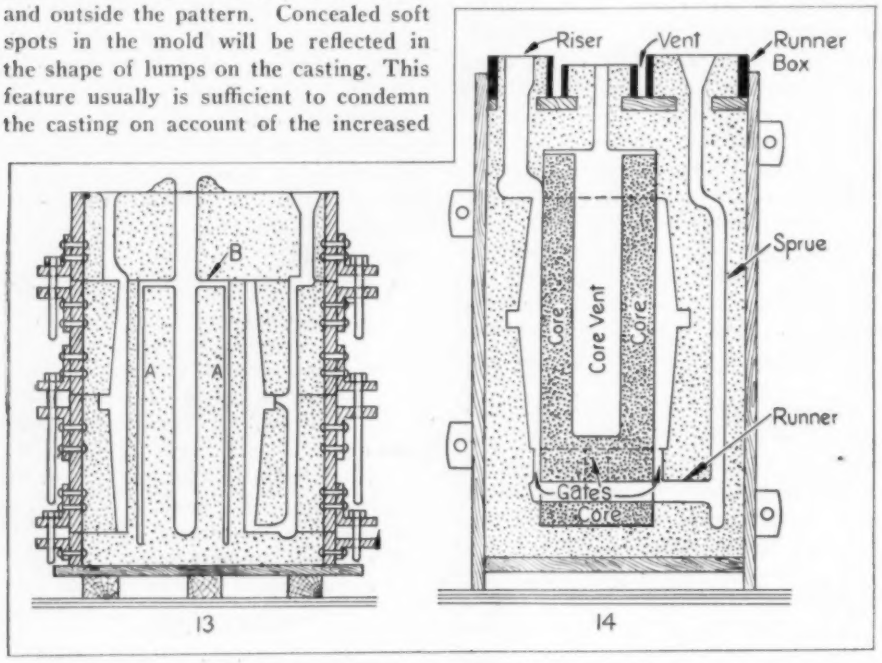


FIG. 3—METHOD OF MOLDING A BUSHING FROM A PATTERN THAT LEAVES THE ITS OWN GREEN SAND CORE IS SHOWN ON LEFT THE SAME BUSHING MADE WITH A DRY SAND CORE IS SHOWN TO THE RIGHT

weight and the excessive machining cost. Where it is necessary to make one of these molds in a built up flask made from several sections of shallow flasks provided with the usual short pins, it will pay to attach long guide pins to the upper cheek. With short pins the sand will have a tendency to break away and the number of good lifts will not average more than one in ten.

Contrast between an entire green sand mold and one in which a dry sand core is employed, is shown in Fig. 3. At 13 a mold is shown made from a pattern molded vertically and one that left its own green sand core. The mold is made in a four-part flask. At 14 a mold is shown molded horizontally in a two-part flask from a split pattern and then turned up on end before it is poured. A dry sand core is set in the center. In the second mold both halves of the flask are barred and the sprue, vents and risers are carried through suitable openings in one end of the flask. The respective openings are made large enough to provide a thickness of at least one inch of sand between the metal and the wood. Nails driven into the wood and projecting into the opening help to retain the sand in place.

While making up the runner and risers the molder must exercise the greatest care to prevent loose sand from falling into the mold. This is one of the unsatisfactory features of this method. Where several castings are ordered the flask extension may be split in halves and firmly attached to the respective halves of the flask. They are rammed as part of the mold and clamped together after the mold is assembled by dropping an iron band around them. A wedge squeezed between the band and the frame binds the two halves together firmly.

Gates at Bottom

The method of gating the casting is illustrated at 14 Fig. 3 where six broad flat gates are shown connected to the lower edge of the pattern at one end and to a broad, flat runner encircling the core at the other end. A long core print is required to accommodate this style gate because the gate either is filed in the core or cut in the green sand core print in the mold. The upright runner may be given as many bends as are considered necessary to *break the fall* of the metal, a feature of course which is dependent on the relative weight of the casting and the total height of the runner. The pouring head may be flared as shown in the illustration, or what is considered a better method may be adopted, in which a flat bottom basin is provided with a piece of slab core in the bottom. A hole in the slab core over the runner is closed with a plug which is removed after the basin is filled with metal. In this manner it is possible to keep the sprue *choked* all the while the mold is filling, a desirable feature. It is necessary to clamp securely molds of this character and proper precautions should be observed to prevent the clamps from falling off. The flask joint should be sealed with wet sand to prevent a run-out.

If the flask is burned at the joint to a slight extent, wet sand rubbed in the joint may be sufficient, but if the burned area is extensive a mixture of two parts sand to one plaster of Paris will be found more efficacious. It will set hard and stick fast.

As a result of pouring the metal through a number of gates at the bottom, the molten metal rises uniformly and fills the mold rapidly and with a minimum of lateral travel. The temperature of the metal is the same at all points of the ascending circles and if the sand has been vented properly—a subject to be considered in a future article—the chances are all in favor of a solid clean casting, one that will present no defective spots under the finishing tool.

Distort Wood Pattern

Where a pattern for making a mold similar to that shown at 13 Fig. 3 is formed of wood and designed to leave a metal thickness of ½ inch it is not advisable to ram the core first. A possibility exists of springing the pattern out of shape, producing permanent damage and resulting in over size castings. The pattern will withstand comparatively severe pressure exerted from the outside and, therefore, the outside sand should be rammed first. This does not mean that the entire body of sand on the outside of the pattern should be rammed before any sand is rammed on the inside. It simply means that each succeeding course of sand is rammed first on the outside and then on the inside. In that manner both sides are brought up approximately together.

A sprue not over 1-inch diameter is large enough. Where a larger sprue is used the metal drops and rebounds from side to side in its descent. Unless the sand is extremely open and at the same time tenacious it will not withstand this action but will cut and scab and the loose sand will wash into the casting.

These castings should be poured with what is known in the foundry as *hot* metal. Where the sprue chokes before the mold is filled it is evidence not that the sprue is too small, but that the metal it to cold. Metal at that temperature would not produce a satisfactory cast-

ing even if the sprue were large enough to convey it into the mold and to every portion.

The manner of venting the core is shown in the cross section 13 Fig. 3. A large vent is provided in the center and a circle of smaller holes is punched with a ¼-inch diameter vent wire about one inch away from the pattern and about 2 inches apart. The small vents are connected to the vent in the center by a series of channels cut in the sand and when finished the design on top of the core will resemble the hub and spokes of a wheel.

The most difficult feature of this method is experienced when the molder attempts to lift the first cheek. The pattern cannot be rapped in the usual manner because the first blow probably would break a piece out of the thin pattern. The best method is to attach a vibrator to the bottom board. Where no vibrator is available a piece of wood approximately 4 x 4 inches may be laid on the floor 3 or 4 inches distant from the flask. A piece of 2 x 4-inch scantling 2 or 3 feet long may be rested on the block with one end jammed under the bottom board and with the other end elevated in the air to a corresponding angle. While one man lifts the cheek a second man raps on the scantling with the bare fists thus imparting vibration to the entire mold. This precaution will assist materially in securing a clean lift.

Use Care In Lifting

However, where no long guide pins are provided the pattern will have to present more taper than usual at each end. Where any part of the sand in the cheek is broken in the lifting process, it may be repaired after the pattern has been drawn. The cheek is inverted and the pattern dropped into place where it remains until the repair has been effected. The broken part is filled with finely screened sand packed with a small stick on the fingers, depending on circumstances; usually where the space is small the fingers are the most satisfactory tools to employ. In most cases it is advisable to *toe nail* the patched area with long nails to prevent the sand from falling away when the cheek once more is inverted. Also it is advisable to try the cheek off and on and make certain that the adjoining surfaces touch each other properly, otherwise it may be found later that the joint has been crushed or that a fin has been left through which the metal finds its way, in either case resulting in a scrap casting.

A perfect cheek lift will reduce subsequent work and, therefore, every effort should be bent to securing lifts of this character. The pattern easily is drawn after the upper cheek has been removed. The lower cheek then is lifted and after the various parts of the mold have been blacked with plumbago applied with a camel's hair brush and afterward rubbed with the fingers the mold is reassembled and poured. Of course, the gates are cut before the face of the mold is covered with plumbago. In a general way it may be stated that where a dry sand core is employed a greater number of castings will be produced per day than where the pattern leaves its own core. In addition a greater number of sound, solid castings will find their way into the machine shop where dry sand cores are used.

How and Why in Brass Founding

By Charles Vickers

Molding Pattern Metal

We are making pattern castings but experience difficulty in getting clean castings, and as the finish allowance is small should any specks show like the ones on the sample we are sending, the castings cannot be used. We use an alloy of copper 87 per cent; tin 7 per cent; zinc 3 per cent; lead 3 per cent. The molds are not baked, but we use a fine grade of sand. At what temperature should castings of the kind shown by sample be poured? We use coke-fired furnaces for melting. We would also like the formula for a soft bronze.

The defects in the sample sent are caused by sand cut from the gate or other parts of the mold; it is strictly a molding proposition, and has nothing to do with the manner in which the metal is melted or the composition. The alloy given is a good one and will do the work it is being used for. The castings will come cleaner if the molds are sprayed with molasses water before being floured, and are left open until ready to pour, then are skin-dried with a gasoline torch. The pouring temperature of the alloy cannot be given in degrees Centigrade or Fahrenheit, because it is a function of the thickness of the castings. In this case they are thin; therefore, the metal will probably have to be as hot as possible by the time it gets to the molds.

What is required in this case is a good molder, and although this frank statement may give rise to argument, it will take a lot of the latter to make the castings clean. Be careful of the bottom of the sprue, and see that this spot is not so hard the metal will scab the mold at this point. A facing of 20 parts sand, half new and half old, mixed with one part of flour will help materially to prevent this cutting away of the mold. A soft metal is copper 85 per cent; tin 5 per cent; zinc, 5 per cent, and lead 5 per cent.

Red Metal for Patterns

We would like a formula for a red metal suitable for making patterns.

The following alloy makes clean, orange-colored castings and is suitable for a pattern alloy.

Pattern Alloy

	Per cent
Copper	89
Tin	5
Zinc	3
Lead	3

Aluminum Die Castings

We are figuring on casting aluminum automobile pistons and desire to know as much as possible about the die casting, or permanent mold process.

There is no such thing as a *permanent* mold as all molds so-called wear out in time. Therefore, a better term would be semipermanent or long-life molds. Both die castings and chill castings are made in semipermanent molds, but there the resemblance ends, as a die casting is a greatly superior piece of work in that by this process, castings are turned out within close limits to the working size and finished shape. In fact, die castings, whether made by application of pressure to the molten metal, or not are intended to eliminate finishing operations by hand tools or machine. Chill castings, or castings made in metal molds, like sand made castings, must have a certain amount of finish allowed. The semipermanent mold is used because it may have some advantages over the sand mold, and is much less costly than the die mold.

Cast aluminum pistons frequently are made in cast-iron molds, which are worked hot, and have to be preheated before the day's operations are commenced, but once work is started the metal keeps

them heated. Such molds last for about 15,000 castings, and to get production it will be evident that some mechanical means of operating the hot molds must be adopted so that they can be opened and closed with certainty. Before starting to install such molds, it would be advisable to work the best methods of gating, by making sand castings which will eliminate much experimental work on the semipermanent molds.

An output of around 200 pistons per day should be attained per mold.

Cheap Brass Is Easy To Machine

We have difficulty casting brass radiator elbows, S-bends and outlets. These patterns are mounted from 4 to 20 on a plate and the walls of the castings are about ⅛ inch in thickness. The difficulty is to get the castings to run, although we have changed the gating so that we think the gates are as good as it is possible to get them. We have thought it possible we are carrying too much copper in our mixtures, viz;—80 to 85 per cent, and we desire your opinion on the subject of using less copper and more zinc; do you believe this would make a more fluid alloy?

Changing the mixture from a red brass to a yellow brass, for that is what increasing the zinc would mean, would not help in running the castings, unless a radical change could be made. This radical change would consist of adding aluminum to the yellow brass, and as it would be foolish to add aluminum to what is known as a good casting yellow, containing from 20 to 27 per cent zinc, and a few per cent of lead and tin, because it would make this comparatively expensive mixture look like the cheaper mixtures, the radical change would mean further putting in not less than 40 per cent zinc. If there is machine work to be done on the castings, it will be necessary also, to add lead to the mixture as follows:

CHEAP YELLOW BRASS

	Per cent
Copper	56.00
Zinc	40.00
Lead	4.00

Aluminum, 2 ounces to each hundred pounds of brass.

To add the aluminum with certainty, it is advisable to make a mixing alloy consisting of 95 per cent zinc, and 5 per cent aluminum, and add 2 pounds of this alloy in place of two pounds of ordinary zinc. Pour after the metal has ceased to flare from the undisturbed surface. Do not pour when it is flaring or the castings will be dirty. This metal will run anything, the only question that now arises is whether the gates that have been adjusted for red metal are suitable.

Sand Quality Sought in Bronze Casting

We would like to learn how to make a good facing sand suitable for dry sand molds for bronze castings weighing 500 pounds or more. The molds will be dried in the core oven. Can such a facing be backed by heap sand, or must the entire mold be made of the facing?

Facing sands for dry sand molds must be somewhat on the order of a core sand in that they should be porous and strongly bonded so as to hold their shape. A green sand mold is held in shape even against the destroying action of the hot metal by its water bond, and when the mold is dried this bond is lost and a scratch of a finger breaking the thin crust that is formed is enough to destroy the mold.

A favorable dry sand mixture requires one part new molding sand, two parts old molding sand, mixed dry with flour in the proportion of one part flour to 20 parts sand. This is dampened to the proper temper with thin clay wash. Such a mixture is less permeable than the sands of which it is composed, because of the addition of clay and flour. Therefore, to make successful castings, both the new and the old molding sand has to be of a coarse grade, and the chances are that a 500-pound casting made in a mold of such sand would not require drying but could be cast green, just as well.

Facing sand mixtures given in terms of so much new and so much old molding sand, then mean nothing, the important thing is the grade of fineness of the sand and strength of bond. These properties being unknown it is foolish to give a formula calling for so much old and so much new sands, etc. If the sands used are finer than a No. 3 grade, mix with them from one to two parts of lake or silica sand, and put in either flour as a binder or dextrin if available, and make a few cores shaped somewhat like a brick and dry them in the core oven. If, when cool, these can be blown through easily and are strong and firm, that is the mixture to use for facing the molds in that particular shop. If more binder is required when the bricks are tested, simply add more and make more cores until a permeable core is obtained. Permeable means that the breath will pass through easily. After the pattern is drawn from the mold, slick the sand and firm all corners, and nail them where it is likely they will break away. Then to finish the mold swab it with plumbago wash, then run it into the oven.

The facing sand can be backed up with heap sand, but do not be too sparing with the facing sand for a dry sand mold. Build it around the pattern two or three inches thick, and before drawing the pattern, ask yourself if the gases when driven through the porous facing are likely to be stopped and driven back by the heap sand being too close. Take no chances and use a ¼-inch diameter vent wire liberally at the junction of the heap sand and the facing sand, so there will be no chance of any backing up of the gases by the heap sand filling. The idea is to make a mold dry, hard and porous with with free outlet for gases, so the metal will lie against the mold quietly and without any quivering.

Acid Resisting Bronze

Will you inform us what in your opinion makes the best acid resisting bronze for service in the sulphite department of a paper mill making news entirely?

What formula makes the best bronze for the use of paper mills is a debatable subject and we do not care to go on record as favoring one especial alloy more than another. However, the following alloy makes a good bronze for such work: Copper, 82 per cent; tin, 8 per cent; lead, 8 per cent, and zinc, 2 per cent.

A little phosphorus is advisable also, and about two ounces of the 15 per cent alloy of phosphor copper should be put in with the copper and melted therewith to give it a chance to oxidize at the expense of the cuprous oxide in the copper.

Coloring Aluminum for Golf Clubs

Will you kindly advise us how it is possible to color cast aluminum, making it black, or nearly so, something on the order of gun metal? We have an inquiry for golf putters to be of cast aluminum, and to be dark in color.

The more satisfactory way of coloring aluminum castings would be to bake on a coating of enamel or Japan varnish. However, the No. 12 alloy may be colored black by simple immersion in a rather weak solution of orthophosphoric acid in water. The castings must be suspended in the acid mixture until coated with the black coloration. They must hang free and not touch one another. After the color has been obtained the castings must be removed without being touched and be suspended in a dry warm place to dry, when the coating will be strongly adhering. However, while it is damp, the coating is easily rubbed off. When dry, the articles should be lacquered. Another method of coloring aluminum is to dip the articles in a solution of cobaltous nitrate, then expose them to heat until the color comes. Quite a strong heat is necessary for the black.

Cores Are Responsible for Gas Bubbles

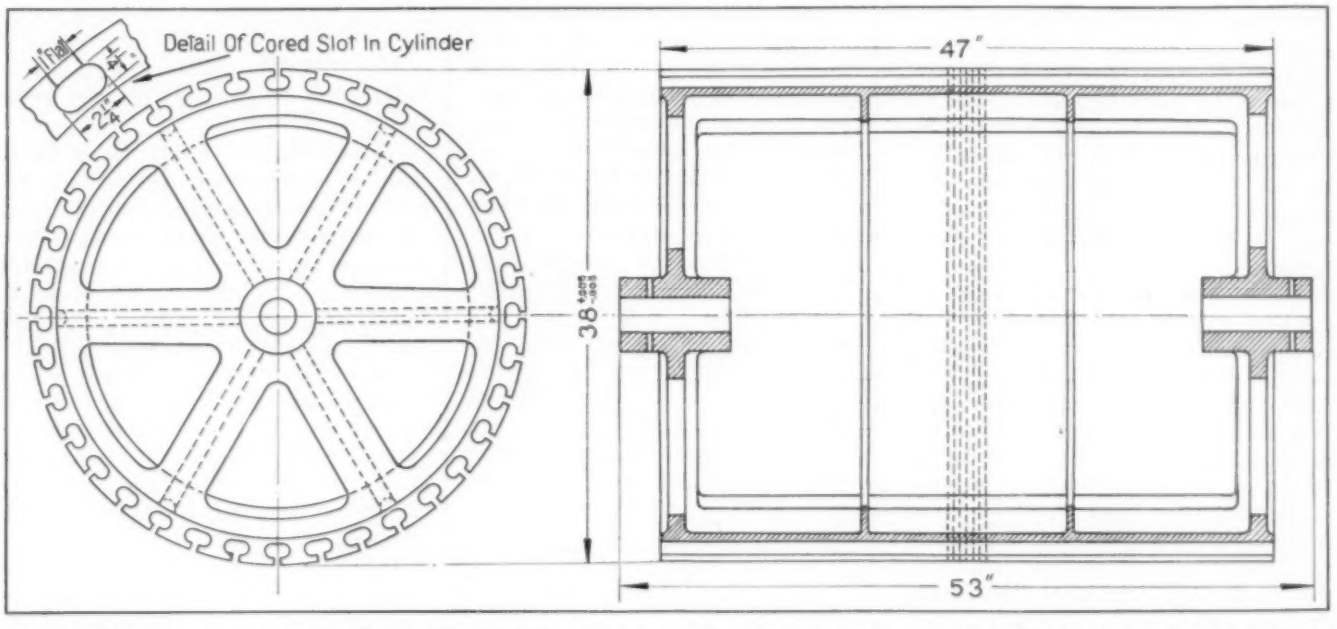
Question: We are attaching a blueprint of an iron cylinder casting with which we are having trouble. The casting is molded on end and gated in the center. After the face of the casting is machined we find holes from ½ inch to 1½ inches deep scattered over the surface. The surface of the holes is clean and bright which would seem to indicate that they are caused by gas and not by dirt. We shall appreciate your opinion on the probable cause of the trouble and also the remedy you may suggest.

Answer: You do not state whether the mold is made in green or dry sand, whether it is made in a flask or in the floor, or whether it is poured with hot or cold iron. Any one of these factors may have an important bearing on the problem. A good casting may be made either in green or dry sand, in the floor or in a flask, provided the molder is competent and perfectly familiar with that particular method. Otherwise the method will be responsible for trouble. However, in this instance we are inclined to the opinion that the gas holes in the casting can be traced directly to the 36 long *T*-slot cores attached to the outer wall of the mold. These cores practically are surrounded by iron and the gas which normally should escape through the narrow neck, backs into the metal and stays there.

On account of the peculiar shape and comparatively fragile character of the cores the coremaker may be tempted to increase the quantity of the binder, for the same reason he may omit proper vents and the result is a core against which the iron will not lie quietly. It will boil and bubble and in a thin section many of the bubbles will be trapped by the solidifying metal. When this condition is multiplied by 36 it is not surprising to find gas holes from ½ inch to 1½ inches deep all over the face. It is barely possible that the cores are made satisfactorily, but no provision has been made in the mold for the escape of the gas. We suggest that you check up personally every feature in connection with these cores and satisfy yourself that they are made and placed properly. Workmen are careless at times, but it is useless to expect them to admit it.

Clean sharp sand bonded with oil usually is employed for cores of this kind. However, where the coremakers are accustomed to other binders either dry or liquid, satisfactory cores are produced. On account of the length of the cores we assume that they are made in two or more sections and since it is desirable to fasten them in place without nails we assume that the core prints are at least 2 inches deep. If the core is made in two parts in a half box and then pasted, a vent can be scattered down the center of the rounded part and other connecting vents can be scratched to the edge of the print before the two halves of the core are pasted together. If the entire core section is rammed as a unit in a two-part corebox held together temporarily with clamps and separated to remove the core, a long vent rod can be inserted in the rounded part of the core through a hole in each end of the box. This rod is pulled out before the core is turned on the plate. A vent wire is employed to jab vent holes about 6 inches apart through the sand forming the core print.

In ramming the mold a narrow girdle of fine coke is placed on top of each course of sand in such a manner that it touches each core print. The coke is continued at four points toward the corners of the flask where suitable openings are provided to conduct all the gas away from the mold. The mold should be skin dried or dried in the oven and if the cores are tucked in place before the mold is blacked they will require no further anchorage. The large center core may be partly to blame for the bubbles. If the surface is too hard, or if the vent does not escape freely it will cause the iron to boil. Fill the inside with coke or cinders and take a vent off through the cope between each pair of arms. Do not be niggardly with the vent holes. Six 4-inch openings extending through the core from end to end in addition to the pile of coke in the center, are not excessive. Lack of proper vents is responsible for nearly all the castings that are scrapped on account of gas holes.



BLOW HOLES IN THE CASTING ARE CAUSED BY GAS FROM THE LARGE NUMBER OF T-HEAD CORES ATTACHED TO THE OUTER FACE OF THE MOLD

The American Brake Shoe & Foundry Co. has purchased four acres at North Kansas City, Mo., and will use it as the site for a foundry which will be started at once.

Electricity Applied in Foundry

Show Advantages and Disadvantages of Heating, Annealing and Nonferrous Melting Furnaces Using Electricity—Different Types Are Discussed—Foundrymen's Abuse of Cranes Is Pointed Out

BY LEONARD W. EGAN

IMPORTANCE of the electrical engineer to the foundry, not only in keeping up the constantly increasing electrical equipment used in the shop, but in devising new and special applications of such equipment, is emphasized by Leonard W. Egan, special engineer the Ohio Steel Foundry Co., Lima, O., in an article discussing the complete electrification of the foundry industry, presented at the convention of the Association of Iron and Steel Electrical Engineers, held in Buffalo Sept. 24 to 28. In dealing with molding machines the author says that two outstanding features which might be called epical in the electrification of machine molding have been brought out in the last few years. These are the rollover, jolt, pattern-draw machine with electrically operated pattern-draw and rollover, equipped with an electrically operated runout car; and the machine which packs the sand by throwing it into the mold, the former being built by the Osborn Mfg. Co., Cleveland, and the latter by the Beardsley-Piper Co., Chicago.

All equipment in the foundry to which electricity is applied is discussed by the author, who cites the advantages and disadvantages of each. In reference to core ovens he says that while some types of cores can be baked more cheaply in fuel-fired ovens than in ovens heated by electricity the following factors should be considered when deciding the question as to which type of oven to install: saving in rejections; improvement in the quality of the core, and hence in the casting; cost of power; cost of attendance; and cost of upkeep.

Mr. Egan calls attention to the hard usage the foundry crane is subjected to and says that in the average foundry the cranes receive an enormous amount of abuse, the majority of which is unnecessary and all of it without any consideration of the effects produced. The use of a footbrake is a rarity in a foundry; the author has viewed cranes in a foundry without footbrakes, fuses or other current protection, and the hoists without either load brakes or arranged for dynamic braking. The cranes or their trolleys are used for dragging cars, buggies and flasks around the floors and from one place or building to another, all of it without consideration for the effect on the crane in general or the motors in particular. Usually the trolleys are equipped with a 3 to 5 horsepower motor, instead of one of 15 horsepower which should be supplied where this type of service is required.

Experience Grows

COMMENT is heard sometimes that the development of the electric furnace for melting metals has suffered because the furnaces were designed by electrical engineers who did not have the metallurgist's or the foundryman's viewpoint. The electrical engineer is obtaining this viewpoint more and more every day because electricity is now such a necessity in nearly every branch of the foundry work that engineers trained in the industry are growing up with it. In the present paper an engineer who deals daily with foundry problems has set forth his views on the application of electricity in the foundry, particularly of the electrically heated nonferrous melting furnaces. These views therefore are highly valuable.

Product Uniform

In considering the merits of the electrically heated annealing or heat treating furnace the author says that under average foundry conditions the electric annealing furnace cannot compete with the combustion type of furnace in fuel costs but where the uniformity of the product or nicety of the treatment is involved, the electric furnace has no equal. Heat treated castings have not heretofore been considered to any great extent but rather it has been largely a question of getting sufficient section in the casting. However, the near future will see a reduction of the section and weight of castings with a corresponding increase in strength, necessitating heat treatment, and this will open a field for the electric treating furnace. Mr. Egan then enters into a full discussion of the electric furnace as applied to brass melting and says:

In the melting of nonferrous metals the electric furnace is finding a broader application every day. In the opinion of the author, the development of the electric furnace in this field has been more significant and far-reaching in its effect than in any other branch of the art.

In entering this field it far outclasses the best production practice of any of the combustion furnaces in every factor, and from every standpoint except perhaps the first cost of the installation. It greatly simplifies the labor problem and renders the manager independent of the melter. It permits the routine repetition of the melting schedule which has been reduced to the mere charging of the metal into the furnace, stirring and skimming it, if necessary, and when melted, pouring it. The time and temperature of pouring is decided by pyrometer and can be placed under the eye of the manager or superintendent at all times. The judgment of the melter need have no place in the schedule.

In this discussion we are considering only the four principal types of furnace that are what we would consider as applicable to the brass and aluminum foundry. They are the rocking arc furnace, the muffled arc furnace, the resistance furnace and the induction furnace. The four types represent practically the entire field of commercial, electric melting, and the few vertical electrode furnaces of the steel melting type that are in use in melting nonferrous metals have not been considered.

The rocking arc furnace was developed by Dr. H. W. Gillett, the United States bureau of mines, during the war. A patent was taken out on the furnace itself and later this patent was donated to the American public. In this way any one desiring to use the furnace may do so. The rocking mechanism was developed by the General Electric Co. The furnace is manufactured by the Detroit Electric Furnace Co., Detroit.

The furnace is a horizontal cylinder with a refractory lining and having a

horizontal electrode passing through a round opening directly in the center of each of the cylinder ends. A hand wheel is provided for moving the electrodes in and out. An arc is formed in the center of the furnace, the heat of which is radiated to the walls and the bath. The furnace rests on a roller mechanism somewhat similar to that of the metal mixer in the steel plant. This mechanism rotates the furnace first in one direction, then reverses it and rotates it in the other. In this way heat is transmitted from the arc to the walls of the furnace and is in turn wiped off the wall by the metal as it passes over it. In addition, heat is radiated to the bath itself directly from the arc proper. The arc does not come in contact with the bath as in the steel melting furnaces and in reality it is of the indirect arc type.

The principal advantages claimed for this type of furnace are the low kilowatt-hour consumption per ton of metal melted, the ability to melt all grades of scrap and turnings, and the speed of melting. This furnace is exceptionally rapid in its action and for heavy production has large capacity per unit.

Arc Near Metal

Some of the disadvantages of this type of furnace are the proximity of a high temperature arc to the metal, the hand operation of the electrode, the necessity of pouring the heat when it is melted, and the dependence of the furnace upon the rocking mechanism and water cooling at the electrode ports. This furnace is made in large and small units as low as 200-pound capacity, single phase. The current consumption is in the neighborhood of 200 to 225 kilowatt hours per ton. All of the metal may be poured, if desired, each heat.

The muffled-arc furnace was developed by the General Electric Co. during the war, and at that time was made in the large size only, and was a combination of smothered arc and resistance type. Later on other types were made in smaller units having a hearth capacity of about 950 pounds and a melting rate of 500 pounds per hour. The furnace is two phase, arranged with a cross electrode embedded in the brick work of the hearth which connects with the two bottom electrode blocks. The return of the two-phase current supply is fastened to this cross electrode.

Heat is generated by the two short arcs drawn between the upper electrodes and the bottom electrode blocks; the arcs are smothered by crushed carbon which surrounds them. The heat is transmitted to the metal by contact with the heated bottom electrode blocks which are in direct contact with the bath. Some heat is given off by radiation of the arcs and reflected by the roof. The furnace is equipped with electrode regulators, motor operated, is hand tilting, and arranged for water cooling of the electrode ports.

The power consumption on 8-hour melting is 400 kilowatt hours per ton for yellow brass, 60/40, and 470 kilowatt hours per ton for red brass, 80/20. The furnace has a rating of 120 kilowatts in transformer capacity. The hearth capacity is approximately 1000 pounds with a melting capacity of 500 pounds per hour, the melting practice being to pour only 500 pounds of the hot metal, charging the same amount of cold metal into the unpoured remainder of the bath. The furnace operates at a power factor of approximately 95 per cent.

Some of the advantages claimed for the furnace are a large source of heat, at a comparatively low temperature; ability to measure and control the temperature of the metal; a neutral or reducing atmosphere; freedom from contaminating gases; and freedom from agitation of the bath, allowing the dirt and slag to float to the surface where it can be skimmed off.

Some of the disadvantages are the proximity of an arc to the metal in the event the arc is not properly smothered; water cooling of the electrode ports; trouble in holding the unpoured heat for long periods of time and amount of auxiliary equipment.

The Bailey resistance furnace was developed by the Electric Furnace Co., Alliance, O., now of Salem, O., somewhat earlier than either of the two preceding types. The furnace is made in different sizes, the one in most general use having a hearth capacity of 1500 pounds a melting rate of 500 to 800 pounds per hour and approximately 100 kilowatts in transformer capacity. Briefly, it is a circular shell with a refractory lining, hand tilting and arranged so that the roof can be raised by a hand wheel for renewing the resistor material. It is equipped with a trough of silicon carbide filled with crushed carbon which forms the resistor or heating element.

Heat is radiated by the carbon resistor to the roof and is reflected to the bath; some heat also is radiated from the sides of trough to the bath. The trough itself becomes conductive after being heated and forms a part of the resistor, a portion of the current being carried by it. It is customary to pour the entire bath each heat, the time of which is about 2 hours. The cold stock is then charged into the furnace, stirred, and skimmed, if necessary, then poured.

The current consumption is approximately 300 kilowatt hours per ton, and the metal loss under 1 per cent. The furnace requires no auxiliary apparatus or water-cooling. The furnace is single phase and operates at approximately unity power factor, the nature of the load being comparable to the same capacity of incandescent lighting load. Secondary taps are brought out from the secondary of the transformer, to points on a hand-operated switch. The voltage is varied by moving the switch from point to point, thus controlling the electrical input and the temperature of the furnace.

Can Skim Metal

Some of the advantages claimed for this type of furnace are uniformity of the metal by reason of the soft reflected heat, the temperature of the roof, the hottest part of the furnace, exceeding that of the bath by more than 300 degrees Fahr.; the metal can be skimmed and stirred at will; the unpoured heat can be held indefinitely without disturbing the composition of the metal; a neutral or reducing atmosphere; absence of contamination from gases; complete control of the temperature and manipulations; flexibility of operation; low metal loss and absence of auxiliaries and moving parts.

Some of the disadvantages are that the roof must be raised and fresh carbon added to replace wastage; and the possibility of breakage of the carbide trough.

The Ajax-Wyatt induction furnace was developed during the war, largely for the casting of cartridge case slabs of yellow brass. It is manufactured by the Ajax Metal Co. of Philadelphia, the 60-cycle furnace in 80 kilowatt size having a hearth capacity of 1500 pounds. The furnace is circular and has a refractory lining that has been perforated and burned. This lining is made in a special shape and fits into the shell of the furnace. When the lining is to be renewed the old one is taken out and a new one fitted in place. The operation is comparable to fitting a new crucible into a crucible type combustion furnace.

The circular chamber of the furnace contains the molten bath in one mass; immediately under the bath is the yoke of a single phase transformer, the sec-

ondary of which is a thin shell of metal being melted, constituting one turn around the transformer yolk. A large volume of current at a low voltage is induced in the secondary, or thin shell of metal at the bottom of the bath. The passage of this large current generates heat within the metal itself which is in turn transmitted to the bath above. The magnetic forces within the transformer set up a rotor effect of circulation of the metal which is constant as long as the current is flowing. This circulation is inherent in the induction furnace, and is not peculiar to this or any other type of induction furnace.

Heat by Circulation

As mentioned, the heat is generated at the bottom of the bath and carried to the bath by circulation. The current flows around the secondary in the vertical plane instead of in the horizontal plane as in the steel melting furnace. The temperature is controlled by varying the voltage and the electrical input to the primary of the transformer. The furnace is either nose or trunion tilted; the nose tilted furnace is operated by motors while the trunion tilted furnace may be either hand or motor operated.

The furnace has a hearth capacity of 1500 pounds and a melting capacity of about 500 pounds per hour. The current consumption is 200 kilowatt hours per ton and the metal loss under 1 per cent. It is single phase and has a transformer capacity of 80 kilowatts. No figures are available as to the power factor but it in all probability is not higher than 75 per cent.

Hot metal from some external source must be charged into the furnace to prime it. When the heat is melted only a portion of it is poured, perhaps less than half of it. The same amount of cold metal is charged into the remaining bath and melted, when the operation is again repeated. During the night the unpoured portion of the last heat must be left in the furnace and the current kept on to maintain the metal in a molten state. If the last heat is poured entirely, hot metal from an external source must be charged in the morning as there must be hot metal to form a secondary before heat can be generated within the furnace.

Some of the advantages claimed for this type of furnace are that the heat is generated within the metal itself; control of the temperature and manipulations; low power cost and metal loss; constant circulation of the metal insuring thorough mixing and absence of contamination from gases.

Furnace Must Be Primed

Some of the disadvantages are necessity of priming the furnace with hot metal from an external source which limits its flexibility in foundry practice; special nature of the electrical application; cooling of the furnace primary coil; and circulating currents in the melting of certain grades of metal.

The repulsion induction furnace, built by the General Electric Co., is a recent development. It is built in one capacity only, arranged for nose or trunion tilting. The furnace has a hearth capacity of 1200 pounds and a melting rate of 750 pounds per hour. It follows the same principles as that of the Ajax-Wyatt furnace and is to some extent similar in construction, but differing somewhat in the manner of applying the transformer yoke to the furnace. It is arranged with a refractory lining of special shapes which have been perforated and burned. This lining of special shapes is fitted into the furnace as in the preceding case.

The circular chamber contains the bath in one mass and immediately under the bath and communicating with the circular chamber by two ports is a thin cylinder of molten metal surrounding the primary of the transformer and forming the secondary. This secondary, as in the preceding case, forms one turn in which a large volume of current at a low voltage is induced. The passage of the current through the metal of the secondary generates heat within it, which is in turn communicated to the bath above through the two ports which are located at the ends of the cylinder forming the secondary.

One of the chief differences between the two types of induction furnace lies in the manner in which the metal forming the secondary circulates through and communicates the heat to the bath. In the General Electric furnace it passes up through a port at one end of the cylinder, thence through the bath and down through the other port at the other end of the cylinder. In the Ajax-Wyatt furnace the bottom of the bath forms a sector of the secondary turn and the circulation is a churning action.

Electrical Engineers Note Foundry Needs

COMPLETE stable and dependable electrification in foundries will not receive impetus until foundry managements recognize the necessity for giving a higher rating to the electrical man is the opinion advanced by Leonard W. Egan, special engineer, Ohio Steel Foundry Co., Lima, O., at the seventeenth annual convention of the Association of Iron & Steel Electrical Engineers held in Buffalo, from Sept. 24 to 28 inclusive.

Mr. Egan spoke on the "Complete Electrification of the Foundry Industry" and described various types of electrically operated rollover, pattern draw machines and sand slingers; sand handling systems; electric furnaces; cranes; electric welding methods; and air and electric hoists. He emphasized that apparatus included in the equipment of a foundry should be of the most rugged type and be braced amply. Continuing he said the equipment should be anchored and have heavy foundations and all structural and plate fabrications should have sections of sufficient size to withstand the vibration and general wear that results from the enormous abuse that foundry equipment receives. He advocated the over-motorizing of cranes above that which is in general use in industrial types.

In discussing Mr. Egan's paper, E. S. Carmen, chief engineer, the Osborn Mfg. Co., Cleveland, and past president of the American Society of Mechanical Engineers, traced the development of the jar-ramming molding machine during the past 10 years. He pointed out that foundries appear to be drawing away from the idea of jarring by electrical means, but look with favor upon electric current for turning the mold over and withdrawing the pattern. He maintained that jolting the mold is accomplished best by compressed air, but that rolling over and handling the mold is cheaper when performed electrically than by compressed air.

F. A. Coleman, president, F. A. Coleman Co., Cleveland, in discussing the paper outlined the fuels usually employed in the heating of core ovens including coke, oil, gas and electric current and compared their relative cost. He advocated the increased use of electricity pointing out that current is the

most universal in its location and of the four fuels enumerated the cost of current is the most likely to head downward. He emphasized the fact that control is most vital in the operation of core ovens and cited the importance of the thermostat as a guardian over the electric oven. He concluded his remarks by citing the advantages of drawer and rack type ovens in various kinds of service.

In conjunction with the cost of operating electric core ovens. L. H. Knapp, General Electric Co., Schnectady, N. Y., stated that $0.115 per kilowatt hour applied on one installation in this country. In the opinion of P. H. McShane, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., not enough consideration is given to the purchase of equipment used in the foundry and controlled by motors. Discussion of Mr. Egan's paper was concluded by J. H. Shepard, Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., who stressed the importance of choosing the correct type of current for the foundry and pointed out the danger of overloading cranes.

At the opening of the afternoon session G. H. Shaeffer, Carpenter Steel Co., Reading, Pa., presided. In speaking on "Electric Furnace Phenomena" E. T. Moore, electrical engineer, Halcomb Steel Co., Syracuse, N. Y., and consulting engineer, Crucible Steel Co. of America, N. Y., outlined the details of an elaborate test concluded at the plant of the former company's works on a 6-ton heroult-type furnace. The impression in some quarters that the arcs in an electric furnace stay in certain restricted positions around the periphery of the electrodes and with reference to each other was disproved by photographs taken in conjunction with the test which clearly indicates a variation in the position of the arc around the bottom end surface of the electrode. The paper was widely discussed.

Discuss Electric Brass Furnaces

THAT the nonferrous field is thoroughly awake to the possibilities of electrical melting and is keenly interested in this development is attested by the attendance of over 75 at a round table session of the American Electrochemical society held in Dayton, Ohio, Thursday noon, September 27, and dedicated to a free discussion of electric brass furnace practice. Dr. H. W. Gillett, bureau of mines, Ithaca, N. Y., presided and under his direction the intimate operating details of electrical brass melting furnaces were presented and discussed by engineers, metallurgists, furnace designers, and builders, refractory experts, operating men and power company representatives.

Power rates in various localities, the first subject presented by the chairman elicited a statement from C. F. Hirshfield, Detroit Edison Co., Detroit, offered as an individual and not as the opinion of his company, that if the need arises, public service corporations should stand ready to furnish power to brass foundries at a price which will enable them to compete on a fair basis with other firms, perhaps more fortunately situated with reference to power costs. In other words, power rates should be considered in the same light as freight rates and the community in which a brass foundry is located should, if necessary assume a share of the burden of costs to enable a local manufacturer of castings to work on a competitive basis with rival companies. The average rate for Detroit service was given as 1½ cents per kilowatt hour for average power requirements and as low as 1¼ cents is obtainable.

Questions by the chairman elicited the information that the following rates are available for brass furnace service in the localities mentioned.

Rate per kilowatt hour (Average Cents)—Dayton, O., 1½; Cincinnati, O., 1¼ to 2¼; Bridgeport, Conn., 1.38; Mansfield, O., 1¾ to 2; Erie, 1¾ to 1.9; New York state, 1½ to 2; Buffalo, 0.9 to 1.1; Chicago, 3 for first 3000 kw., 1.1 next 20,000, 0.9 next 70,000.

An Ohio brass manufacturer reported a current consumption of 617 kilowatts per ton in a type of furnace now admittedly obsolete and stated that he could melt as cheaply with that electric furnace as with the oil-fired furnaces in use, with a current rate of 2 cents although this furnace is inefficient. With current at 2 cents and oil at 6 cents a gallon, one foundry gave costs of $22.99 per ton for electric melting and $20.68 for oil. This foundry expressed a preference for the electric method due to the superior quality of metal his practice gave with the electric unit.

For continuous operation on rolling mill materials of less than 75 per cent copper the induction type electric furnace was recommended by Walter R. Clark, Bridgeport Brass Mfg. Co., Bridgeport, Conn. Mr. Clark stressed the unreliability of refractories under service in this type furnace. He stated that linings, particularly the rammed-in types, failed through shrinkage cracks or through softening of the cements at high temperatures. On continuous service magnesite linings lasted only four to five days. Mr. Clark gave a production of 100,000 pounds of metal as the estimated life of a lining which would prove satisfactory and economical for materials high in copper. On materials of less than 75 per cent copper present linings often give well over a million pounds. With the type of furnace used by his company 100,000 pounds would give three to four weeks continuous operation with a week for relining.

John A. Seede, Gereral Electric Co., Schenectady, N. Y., reported as an exceptional performance, a production of 800,000 pounds of 95 per cent copper alloy in an induction type furnace with a lining of which fire clay was used as a base. From 100,000-200,000 pounds ordinarily are considered high figures for these conditions. No clear understanding is had of the differences in conditions which allowed the exceptional life.

H. B. Swan, Cadillac Motor Car Co., Detroit, stated that with an arc type furnace melting 85 per cent copper borings, after 600 heats the lining looked good for hundreds more. It was stated that none of these furnaces in this size has ever been shut down short of 1500 heats. Cases of 2000 heats in one-ton furnaces were cited. N. K. B. Patch, Lumen Bearing Co., Buffalo, described an aluminum oxide hearth in a resistance type furnace that gave from 1½ to 2 million pounds production. This was formed by ramming in a ground firebrick base mixed with corundite clay and fusing it with aluminum borings.

In summing the results of the discussion of suitable refractories, G. W. Bole, bureau of mines, Columbus, O. stated that the linings mentioned by trade names or chemical constituents had ranged from highly acid substances through the neutral to the basic materials. He pointed to the need for investigation on an unprejudiced basis, and predicated upon kinds of materials used. He said that the ideal lining would be one which could be sintered in place in a number of superimposed layers, to obviate the difficulty due to the different expansion factors, and to the fact that shrinkage cranks develop more readily in a hard vitrified surface inadequately supported due to the softer backing material. This recommendation, it was stated, could not be followed in the induction type furnaces described.

W. M. Corse, representing the National Research council urged that the society seek the co-operation of other technical bodies such as the American Ceramic society on the subject of refractory research. G. K. Elliot, Lunkenheimer Co., Cincinnati, chairman of the electrothermic division indicated his intention to suggest this action.

The subject of suitable crucibles was introduced by Dr. E. F. Northrup, Ajax Electrothermic Corp., Trenton, N. J., who described high-frequency induction furnace using a crucible of graphite or other high-conductivity material as a resistor. This crucible is packed in an insulating substance. The crucible holds 150 pounds and as the furnace requires no water cooling connections it may be lifted off its base and carried to any desired point for direct pouring. Dr. Patch recommended the use of crucibles for pouring metals at temperatures from 2100 to 2200 degrees Fahr. Others recommended clay-lined ladles for this service, preheated between trips to the spout for metal. The change in furnace sizes due to the industrial situation was noted by E. L. Crosby, Detroit Electric Furnace Co., Detroit, who stated that during the war and the period immediately following, 2000-pound units or even larger were sought. Since that time the average demand has been for the 750-pound furnace, and a 200-pond type melting from for 15 to 18 heats in a 9-hour day has been favored. In reply to questions, Mr. Crosby stated that the small unit is practically as efficient as the larger sized, due to the rapidity with which a small charge may be introduced and poured.

The discussion was scheduled to end at 3 o'clock to permit those present to visit McCook field as guests of the local committee, but the interest was so great that by vote of those present, the session was prolonged to 5 o'clock.

Johnson & Kunz, 51 Sixth street, Long Island City, N. Y., have recently started a pattern making establishment. Both men have for many years been affiliated with the McGee-Russell Foundry Co.

Matchplates from Sand Oil and Litharge

Question: We have been trying to make matchplates for gated patterns but so far have had no success. Our trouble may be due to the inferior grade of litharge employed or we may not have used the quantities in the proper proportion. Will you kindly advise us of a more suitable material than litharge, or failing that, tell us the correct proportions of the various ingredients to be used in the litharge mixture. We also will appreciate the recipe for making the old fashioned hard sulphur filling for repairing surface defects in castings.

Answer: Hard sand matches are made from a mixture of fine sand, usually dust from the cleaning room, linseed oil and litharge. A sufficient quantity of dry sand is passed through a fine sieve onto a board and spread out. Linseed oil is added also litharge and the material is mixed with the hands until it is a little damper than molding sand under ordinary working conditions. Approximately 1 shovelful of sand, 1 pint of linseed oil and 1 handful of litharge will be required for a small snap matchplate. After the plate has been prepared it is given a coat of black shellac and placed in a dry, warm place for about 24 hours to become thoroughly hard.

A certain amount of experience is required to make hard sand matchplates and of course the same applies to the manufacture of any kind of foundry equipment. If you have a file of back number of THE FOUNDRY you will find a great deal of valuable information on the subject of pattern equipment in a series of seven articles beginning with the issue of Feb. 1 and ending with that of May 1, 1922. In the advertising pages of THE FOUNDRY you may find the names and addresses of firms that supply materials for making matchplates and all other kind of pattern equipment and if you have had no former experience we would sugest that you get in touch with these people. Their materials and instructions will save you a considerable amount of experimental work. The old fashioned hard sulphur filling to which you refer is made by adding 2 parts of sulphur by weight to 1 part of black lead. The sulphur is melted and the lead is added and thoroughly mixed. The mass is poured out on a smooth plate and allowed to cool. A piece may be broken off, placed over the defective spot in the casting and pressed into place with a hot iron. Another material frequently used for the same purpose is made up of 1 part of black pitch and 1 part rosin melted in a crucible and with a sufficient quantity of iron filings added to form a fairly stiff mass. The material is allowed to cool and when it is needed a piece is broken off, laid over the defective spot in the casting and rubbed into place with a hot iron. There are dozens of these remedies if a person cares to go to the bother of preparing them. At one time they probably had a legitimate places but in recent years ready made preparations may be had from any of the foundry supply houses. These give more uniform and satisfactory service and present a surface that cannot be detected from cast iron.

Tries Band Saw for Pattern Work

By M. E. Duggan

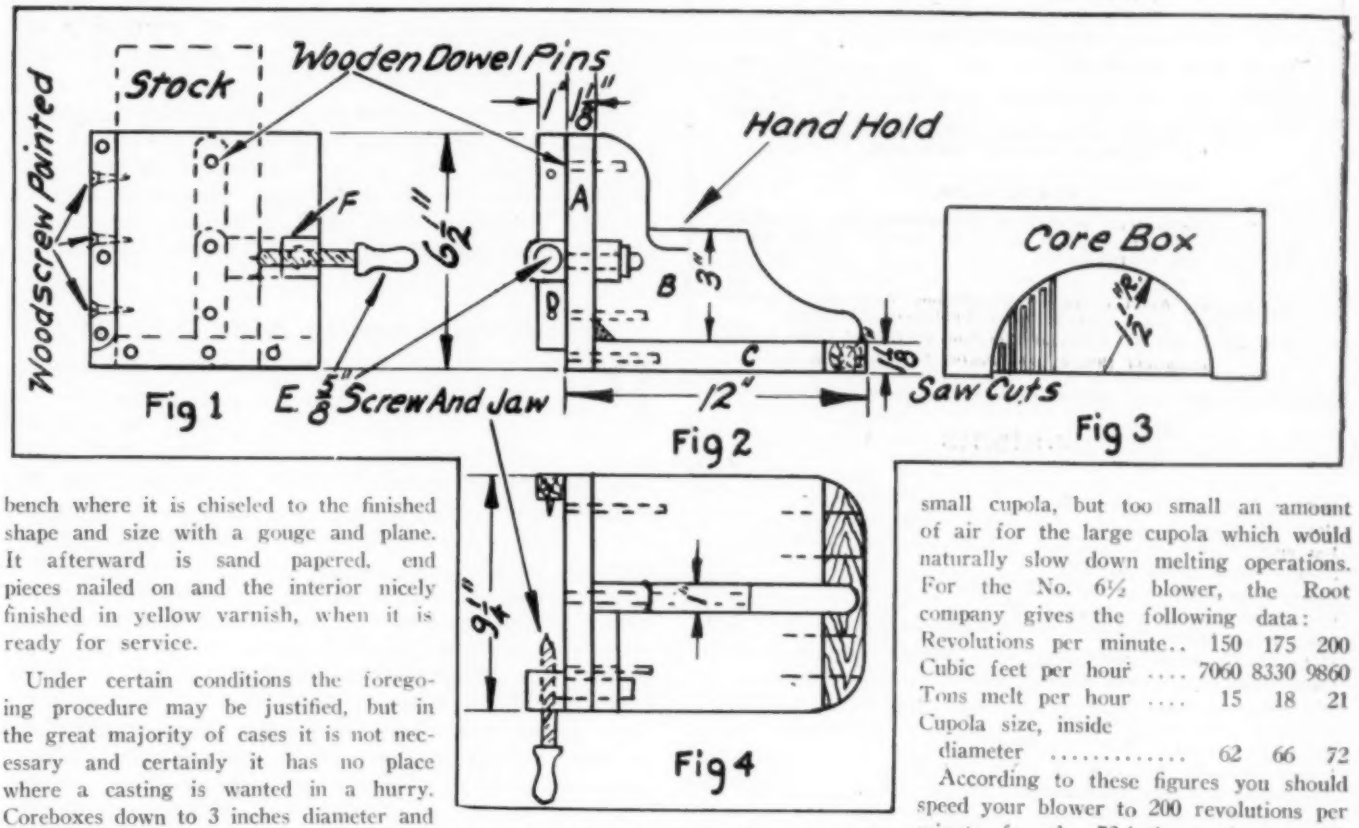
Experience extending over more than 40 years has convinced me that too much attention is paid and too much time wasted over unimportant and therefore insignificant details in the construction both of patterns and coreboxes. For instance, consider the ordinary half corebox employed for making round cores. The patternmaker gets out the stock, strikes the required half circle at both ends, takes the piece to the rip saw and rough cuts it as shown in Fig. 3. He then takes it back to the bench where it is chiseled to the finished shape and size with a gouge and plane. It afterward is sand papered, end pieces nailed on and the interior nicely finished in yellow varnish, when it is ready for service.

Under certain conditions the foregoing procedure may be justified, but in the great majority of cases it is not necessary and certainly it has no place where a casting is wanted in a hurry. Coreboxes down to 3 inches diameter and 12 inches long can be cut and finished on the band saw. In fact a corebox may be made any length by cutting the necessary number of pieces and assembling them either temporarily or permanently on a flat board. It is not necessary to waste time checking invisible or light tight joints. A straight edge is employed to check the pieces to a straight line and then they are nailed rigidly in place.

Two pieces of equipment are necessary for making coreboxes in the manner outlined. The first is a narrow saw blade, not over ¼-inch and the second is an angle plate to hold the stock accurately in relation to the saw and the table. Of course it is assumed that the patternmaker is familiar with the operation of the band saw. A 3-inch diameter corebox, 12 inches long cannot be cut with a saw ⅜, ½ or ⅝-inch wide, regardless of its condition, because a wide saw will not turn freely within a circle of that size. It will cut the circle, but if you try a straight edge on the face of the box you will find that the surface is concave instead of straight.

An angle plate is required to hold the stock. To the inexperienced it might appear that a square end on the piece of stock should furnish a sufficient guide, even for a deep cut, but experience does not bear out this view. A well made angle plate that can be depended upon for accuracy is shown in the accompanying illustration. The grain runs in the same direction in pieces *A* and *C*. The pieces *A*, *B*, *C* and the stop strip *D* are fastened together with wooden dowel pins. It is provided with a clamping device made from an old wood clamp jaw and screw *E* and *F*. The ends of pointed screws project from the end of the screw *E* and the stop strip *D* and serve to hold the piece of stock.

With the aid of this simple device, a ¼-inch band saw with six points to the inch, with the saw adjusted accurately at right angles to the table and with a slow continuous feed of the stock to the saw, coreboxes and parts entering into the construction of patterns may be band sawed straight and true to a finish.



AN ANGLE PLATE IS REQUIRED TO HOLD THE STOCK STRAIGHT AND TRUE ON THE TABLE OF THE BAND SAW

Same Blower for Different Size Cupolas

By H. E. Diller

Question--We are operating one 48-inch and one 72-inch cupola using a number 6½ blower made by the P. H. & F. M. Roots Co., Connersville, Ind. The blower is speeded to 100 revolutions per minute and the cupolas are operated alternately. Is this blower satisfactory for both cupolas?

Answer--According to the figures you give in regard to the dimensions of your cupola and the size and speed of the blower, we figure that you are using about the right volume of air for the small cupola, but too small an amount of air for the large cupola which would naturally slow down melting operations. For the No. 6½ blower, the Root company gives the following data:

Revolutions per minute..	150	175	200
Cubic feet per hour	7060	8330	9860
Tons melt per hour	15	18	21
Cupola size, inside diameter	62	66	72

According to these figures you should speed your blower to 200 revolutions per minute for the 72-inch cupola and approximately 100 revolutions per minute for the 48-inch cupola. At 200 revolutions per minute, giving 9860 cubic feet per minute, you would get 591,600 cubic feet per hour, or nearly enough air to melt at the rate of 20 tons an hour, it requiring 30,000 cubic feet to melt a ton of iron.

Will Increase Capacity

Wilfrid Legaré, gray iron founder, St. Martin street, Sherbrooke, Que., Canada, contemplates the erection shortly of a larger foundry building to cope with his rapidly increasing business. The new plant which will have a floor space of 60 x 125 feet, will be equipped with crane and other facilities for the production of gray iron castings up to 5 tons in weight.

THE FOUNDRY

Registered U. S. Patent Office

A semimonthly journal devoted to all branches of the foundry trade

Published by
THE PENTON PUBLISHING CO., CLEVELAND, O.

BRANCH OFFICES

BOSTON.....426 Old South Bldg
CHICAGO.....1147 People's Gas Bldg.
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Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada.....$4.00 a year
Great Britain and other Foreign Countries.....£1:0:0 a year
Single Copies.....25 cents
Copies published three months or more previous to date of current issue, 50 cents each.

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With Profit to All

WHEN the American foundrymen who made the trip to the International Foundrymen's congress return to their accustomed round of duties in their various establishments, it will be with a new respect for old world ability and good will for their gracious hosts abroad. The term which is chosen to typify international amity may vary. Hands Across the Seas; Our British Cousins; Lafayette, We Are Here; Our Dear Allies, and a host of other more or less saccharine expressions of good will arise in times of national fervor and serve to display national emotion of the period. Basicly they are sincere, but unsupported by a mutual acquaintance and common respect, they become meaningless under stress of changing political conditions. When national alliance is supported by personal contact and industrial co-operation, the bonds of friendship are strengthened. All parties to the first international foundrymen's convention have profited, as individuals. Their respective firms have gained through the interchange of ideas on technical subjects. Finally, and by no means the minimum of benefit accrues to those nations represented, whose notable manufacturing and scientific men came into personal contact through a common interest.

Improved Quality Aids Industry

PRODUCTION of malleable iron castings in the United States has more than doubled in the past 10 years. This is a remarkable record for an industry. It was accomplished by two means—improvement in the quality of the product and advertising. Not only was the quality of the iron in the castings improved, but through banding in an association, malleable iron producers have been able to guarantee the product from certain foundries which have produced iron meeting specifications that have been made more severe as the foundries through improved practice have been able to meet them. In the early days when bars from different foundry members of the association were tested at a central laboratory the record of tests was poor. The average ultimate strength in 1912 was 35,000 pounds per square inch and the elongation 5 per cent in 2 inches. Eleven years later, in one month of 1923, the average tensile strength shown by tests from 60 foundries was 54,474 pounds per square inch and the average elongation was 17.25 per cent. Three foundries had an average tensile strength for the period of more than 57,000 pounds per square inch, while the average elongation in each case was more than 23 per cent in 2 inches, and in one case of more than 25 per cent. The advantage of this record is limited by the number of users of malleable castings who are aware of it. Appreciating this fact the association of malleable iron producers have maintained a campaign of enlightenment to bring to the attention of users of malleable iron the improvements being made in the quality of malleable iron. Further, they have been instrumental in raising the requirements of specifications for malleable until now a tensile strength of 50,000 pounds per square inch and an elongation of 10 per cent in 2 inches is demanded.

Trade Outlook in the Foundry Industry

BUSINESS is good in foundry lines. This statement may be qualified or discounted by a few individual instances, but in the main a substantial melt obtains and a fair volume of orders are on hand throughout the industry. The exceptions are confined to a few jobbing lines, to a limited number of manufacturers of high pressure brass castings, and to occasional automotive foundries whose principals have not yet specified. Nor is the slackening in operations or orders general in any of the classes of the castings industry noted. In general, sufficient work is at hand to occupy the available labor force and provide a comfortable backlog of orders.

Construction Recovers

Building construction is staging an unexpected come-back in many sections and consequently stove and furnace works, sanitary shops and general hardware foundries are experiencing a pick-up in orders. August ran ahead of July in building permits in the larger cities, while September probably will show a continued increase in new undertakings. A radiator manufacturer in the Central West has notified its salesmen that it cannot promise delivery under thirty days. A Chicago manufacturer of plumbing sundries, pipe fittings and cast pipe has the largest volume of orders on its books in its history. Although the present is an off season for cast-iron pipe buying, makers are booked through to the first of next year. According to the department of commerce, twelve establishments shipped 84,843 tons of bell and spigot pipe during August and in the same month orders were taken for 84,588 tons. This, too, with the previous months orders reported far in excess of shipments. A sidelight on the far reaching influence of the building construction movement is furnished by a large manufacturer of fire-prevention, sprinkling systems, operating its own foundries, but obliged to order sprinkler heads from jobbing bronze shops.

Malleable Picks Up

Malleable foundries are active, supported by the automotive and railway demand. According to the department of commerce, 112 establishments, having a monthly capacity of 103,068 tons per month made 68,069 tons of castings during August and booked orders for 39,830 tons. The production given is 66 per cent of capacity, an increase of 8 per cent over the preceding month. Machine tool foundries which have stood at the foot of the list on operations for a long period are accelerating production and are working at probably 60 per cent of the 1913 average in line with the manufacture of machine tools, as reported by President E. F. DuBrul of the National Tool Builders' association. A better outlook in machine tool lines is predicted. Farm implement sales are mounting, and the foreign demand has taken a decided brace. In the South, a marked improvement in foundry operation is noted, in line with the large cotton production and favorable prices. September demand for machine tools in that section, was 15 per cent ahead of the preceding month.

Prices of Raw Material for Foundry Use

CORRECTED TO OCT. 11

Iron		Scrap	
No. 2 Foundry, Valley	$25.00	Heavy melting steel, Valley	$16.50
No. 2 Southern, Birmingham	21.00 to 23.00	Heavy melting steel, Pitts.	16.00 to 16.25
No. 2 Foundry, Chicago	26.00	Heavy melting steel, Chicago	15.00 to 15.50
No. 2 Foundry, Philadelphia	23.76 to 24.76	Stove plate, Chicago	18.50 to 19.00
No. 2 Foundry, Buffalo	23.00 to 23.50	No. 1 cast, Chicago	21.50 to 22.00
Basic, valley	24.00	No. 1 cast, Philadelphia	20.00 to 21.00
Basic, Buffalo	23.00 to 23.50	No. 1 cast, Birmingham	19.00 to 20.00
Malleable, Chicago	26.00	No. 1 cast, Buffalo	19.50 to 20.50
Malleable, Buffalo	23.00 to 23.50	Car wheels, iron, Pittsburgh	18.00 to 18.50
Coke		Car wheels, iron, Chicago	18.50 to 19.00
Connellsville foundry, coke	$4.75 to 5.75	Railroad malleable, Chicago	20.75 to 21.25
Wise county foundry, coke	6.50 to 7.00	Agricultural mal., Chicago	19.00 to 19.50
		Malleable, Buffalo	20.00 to 21.00

Iron Output Declines

Another month of curtailed blast furnace operation is noted by the *Iron Trade Review* in its statistical report on pig iron production for September. The total of pig iron made in September is given as 3,123,611 tons as compared with 3,448,886 tons for August. This is 744,611 tons below the peak production noted in May, 1923 and shows a loss of 325,275 tons for the past month. On a daily average basis, September, the shorter month, showed a loss of 7134 tons per day, the daily average output being given as 104,210 tons per day, compared with 111,254 tons per day for August. Merchant iron showed a loss in September out of line with the state of melt in the majority of foundries. The total output of merchant iron for September was 738,539 tons, which, compared with the August total of 828,163 tons, gives a loss of 89,624 tons. A production of 24,618 tons per day, reported for September, compared with 26,715 tons per day in August, gives a loss of 2097 tons per day. During September, two merchant furnaces were blown in and eight were blown out. Pig iron stocks held by foundries are low and many are urging delivery on contract quotas due. Prompt shipment and delivery are encouraging many foundries to continue to buy on a hand-to-mouth basis, instead of contracting for the quarter or half year in advance as had been the custom. Railway operations are good, with unprecedented freight loadings. Orders for new equipment dropped in September, a total of only 897 freight cars ordered was reported for that month. However, early October is bringing more business.

Nonferrous Optimistic

Brass and aluminum foundries are working at a good rate. The automobile demand is bringing a fair volume of orders, plumbing goods foundries are active, miscellaneous brass jobbing castings are sought. Foundries making bearings for steel mill and heavy machinery service are operating at better than 70 per cent of capacity. Prices on nonferrous metals in New York, according to the *Daily Metal Trade* of Oct. 11, follow: Casting copper, 12.50½c to 12.62½c; electrolytic copper, 12.75c to 12.87½c; Straits tin, 41.50c; lead, 6.85c to 7.00c; antimony, 7.50c; aluminum, No. 12 alloy, open market, 20.75c to 21.75c. Zinc is 6.25c to 6.30c, E. St. Louis. September average prices follow:

(New York Quotations)

Casting Copper	Electrolytic Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc, E. St. Louis
13.436	13.605	7.036	41.663	7.464	25.013	6.461

Comings and Goings of Foundrymen

WALTER M. SAUNDERS of of the firm of Saunders & Franklin, analytical and consulting chemists, Providence, R. I., has assumed the duties as chairman of the joint committee on molding sand investigation of the National Research council and the American Foundrymen's association to succeed R. A. Bull, resigned. Mr. Saunders is well known in the foundry industry, having become a member of the American Foundrymen's association in 1904. Even earlier than this he was

WALTER M. SAUNDERS

active in the affairs of the American Society for Testing Materials, having joined that society in 1902. Mr. Saunders has helped to promote progress in scientific control of foundry methods through his work on committees of these two organizations and the presentation of papers at different times on foundry subjects. For a number of years he served on the committee of the American Foundrymen's association which acted in an advisory capacity to the U. S. bureau of standards in its research work on molding sands, and he has been a member of the joint committee on sand research from its formation.

Palmer E. Hanson has been made superintendent of the Cream City Foundry Co., Milwaukee. Mr. Hanson formerly was superintendent of one of the foundries of the Lakey Foundry & Machine Co., Muskegon, Mich.

Russell R. Clarke recently accepted the appointment to be foreman of the brass foundry at the Erie, Pa., plant of the General Electric Co.

E. I. Hunt, formerly foundry superintendent of the Fox Machine Co., Jackson, Mich., has been made foundry manager of the Jackson Furnace & Foundry Co. of that city.

G. W. Merryfield, formerly superintendent of the steel foundries of the Lorain Steel Co., Johnstown, Pa., is now connected with the Clark Equipment Co., Buchanan, Mich., as manager of its electric steel foundry and wheel plant.

Stanley G. Flagg Jr., head of Stanley G. Flagg & Co., Philadelphia, and a past president of the American Foundrymen's association suffered an accident in which he broke his right arm, while enroute to the International Foundrymen's congress at Paris on the GEORGE WASHINGTON. After his arrival in Paris, Mr. Flagg recovered sufficiently to be able to attend most of the sessions of the congress.

Safety Work in Foundries Features Meeting

Safety work in foundries received considerable attention in the sectional meetings of the twelfth annual congress of the National Safety council, Buffalo, Oct. 1 to 5. One of the successful features of the event was a playlet entitled "A Scene in a Foundry" presented by a group of eight molders and a foreman from the Edgar Thompson works of the Carnegie Steel Co., Braddock, Pa. While the men made a mold and poured from a red-hot ladle, safety rules were demonstrated. One of the men who had lost an eye by the flareback of metal from a pouring gate, exhibited his glass eye as evidence of this. Another man had saved his sight by the use of goggles. The goggles as exhibited were encrusted with metal that had splashed against them. Six hundred delegates witnessed the playlet.

J. M. Woltz, Youngstown Sheet & Tube Co., Youngstown, O., read a paper entitled Fire Protection in Steel Mills and Foundries, and W. B. Booth, Wilson Foundry & Machine Co., Pontiac, Mich., read a paper on Administration Methods and Costs. Fred Bennett, Buckeye Steel Castings Co., Columbus, O., was elected secretary of the metals section, of which T. H. McKenney, Illinois Steel Co., Chicago, is chairman. L. A. DeBlois, E. I. duPont de Nemours Co, Wilmington, Del., was elected president of the national council.

Joins Locomotive Force

G. L. Havel entered the service of the American Locomotive Co., Chester, Pa., on October 1, as plant superintendent. Mr. Havel, who received his early foundry training with

G. L. HAVEL

Pratt & Letchworth Co., Buffalo, during the past 18 years, has filled various positions with the Canadian Steel Foundries, Ltd., his time from 1915 to the present being occupied as superintendent of the company's foundry at Longue Pointe, Montreal. During this period the concern's output of steel castings grew from 700 tons to 2400 tons per month. Appreciation was shown by his former associates, who on Sept. 22 presented Mr. Havel with a case of silver cutlery, including 182 pieces. In the evening of the same day a farewell banquet attended by 65 of the company's officials and foremen, was given at the Auditorium hall. Short addresses were made by Thomas A. Brinkworth, superintendent of the finishing and testing departments; Frank Phillips, and others. J. Campion, plant superintendent presided.

Build New Gear Making Pattern Machine

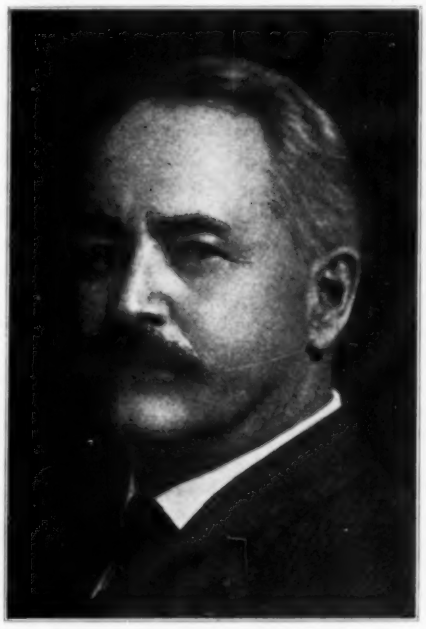
The Link-Belt Co., Chicago, has developed a machine for making gears with one tooth as a pattern. The apparatus shown in the accompanying illustration demonstrates the essential parts of the molding machine. The pattern tooth is made of brass and the block on which the tooth is fastened is mounted on the ram which is adjustable so as to give the correct pitch diameter, and may be moved up and down to get the tooth block in position to hold the teeth.

The flask is placed on a table which may be rotated by hand and centered. The tooth block is placed in position in the flask and each tooth is rammed by hand. After the block has been removed the table is rotated the exact amount necessary to bring it in position for the next tooth. This process is repeated until all the teeth are molded. The apparatus for rotating the table and setting the teeth is run by hand power operating through a set of gears as shown in the illustration.

The advantages claimed for this type of gear molding are the accurate indexing of the teeth and the fact that the pattern has no draft, so the mold attains greater accuracy than ordinary pattern molds. The manufacturer cites as an illustration a gear 14 feet in diameter, made by this machine molding process, which was found to be less than 1-16 inch out of round upon completion and exact in pitch. It also is stated that machine molded gears are less expensive than pattern molded, and particularly so in the larger sizes.

F. N. Perkins Is Dead

F. N. Perkins, who for many years was connected with the Arcade Mfg. Co., Freeport, Ill., and for the past seven years a resident of Chicago, died recently. Mr. Perkins first came in touch with the foundry industry in 1905 through his connection with the Arcade Mfg. Co., acting as salesman for that company until 1916. He was president of the Foundry Supply association in 1908 and was re-elected in 1909. In 1910 he was influential in organizing the Foundry & Machine Exhibition Co. of which he became president in 1912, continuing in this office until the company was disbanded in 1916. Later he moved to Chicago where he has been engaged in the real estate business for the past three years.



F. N. PERKINS

Illustrations Incorrect

On page 640 of the Aug. 1 issue of THE FOUNDRY appeared a description of the method followed in applying a plastic lining to a brass melting furnace at the plant of the Canadian Bronze, Ltd., Montreal. The photographs accompanying this article were not as represented and did not show the actual procedure followed in the case in question. In fact, these illustrations show the application of furnace lining material made by the Carborundum Co., Niagara Falls, N. Y. and the photographs were made several years ago at the plant of the Titanium Bronze Co. of that city. THE FOUNDRY regrets the misrepresentation, which on the part of this publication was entirely unintentional.

Joins Detroit Firm

D. V. Williamson, formerly connected with the American Manganese Bronze Co., Philadelphia, Pa., has been made sales engineer for the Detroit Electric Furnace Co., Detroit, manufacturer of brass melting furnaces.

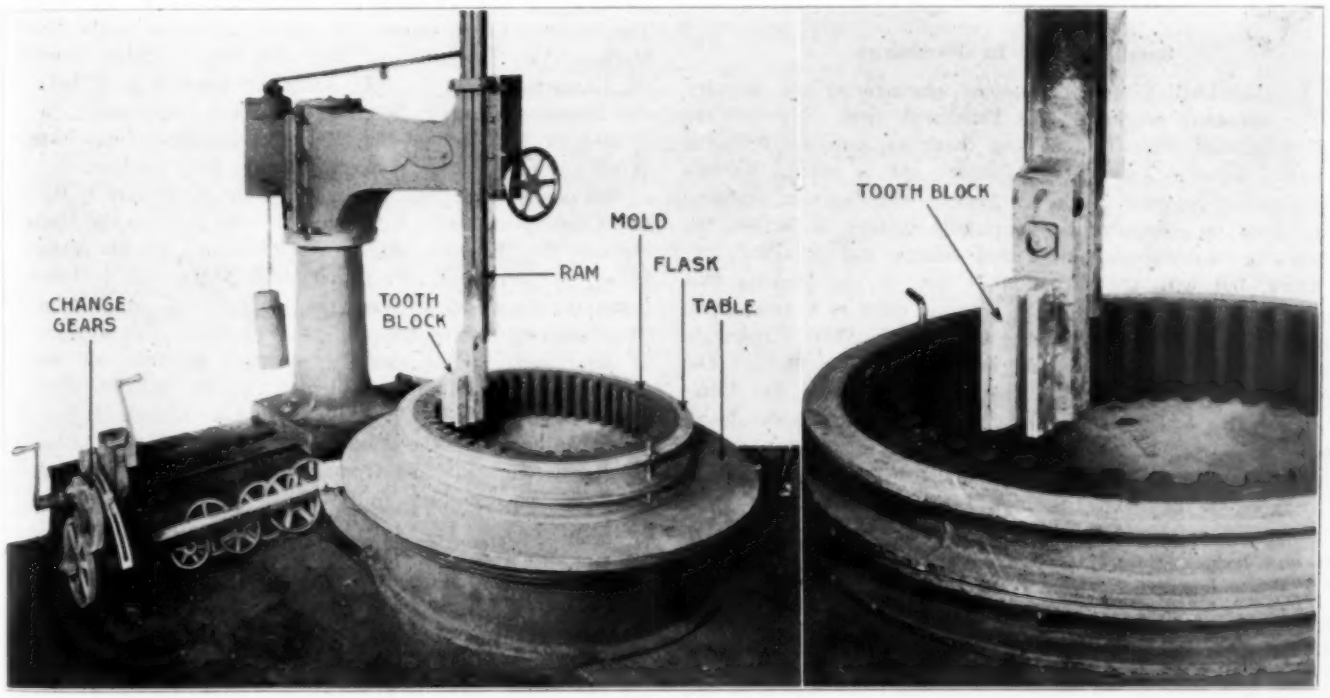


FIG. 1—A ROTATING TABLE BRINGS THE FLASK INTO POSITION, BEING REVOLVED BY THE GEARS SHOWN AT THE LEFT. FIG. 2—A TOOTH PATTERN OF BRASS IS MOUNTED ON A RAM

Equipment Firms Keep Busy

Orders for New Equipment Not Numerous, but Old Orders and Repair Part Buying Keep Foundry Equipment Manufacturers Busy—Crane Orders Have Piled Up—Molding Machines Not Active

LITTLE new business in foundry equipment has developed during the past two weeks, and the number of inquiries has been of less volume. Several projects have been postponed, notably the foundry which was planned for the Youngstown Sheet & Tube Co., Youngstown, O. However, nearly all equipment firms are busy with old orders and replacement demands which are heavy. One eastern equipment firm is working day and night and a firm in the Chicago district is finding it difficult to fill the orders already placed for cranes. Powdered coal is being installed in a number of malleable shops and the Dayton Malleable Iron Co. is making experiments with a view to installing powdered coal in its Dayton plant. A manufacturer of sanitary ware in Ohio, who does not manufacture bath tubs is contemplating the erection of a foundry for that purpose. The National Brake Shoe & Foundry Co., is contemplating building a brake shoe foundry. Orders for sand blast and dust arrester equipment have been placed with the Pangborn Corp., Hagerstown, Md., by the Estate Stove Co., Hamilton, O., and the National Tube Co., Lorain, O. An order has been received by the same company from the Tappin Stove Co., Mansfield, O. The Ford Motor Co., Detroit has placed a large order for sand blast equipment with the W. W. Sly Mfg. Co., Cleveland. This company also received an order for three tumbling mills from the Saginaw Malleable Iron Co., Saginaw, Mich. Kennedy Stinson, president of Stinson-Reeb, Montreal, Canada, is interested in building a steel foundry to take the place of one recently destroyed by fire. The plan is to operate a 1-ton electric furnace to produce 200 tons of castings a month.

Small Orders In Pittsburgh

UNDENIABLY quiet conditions characterize the foundry equipment market in the Pittsburgh field. Nevertheless an occasional order for molding machines, cupolas, tumbling barrels, ladles or cranes for foundry use is noted. Orders for smaller supplies such as flasks, wheelbarrows, riddles, etc., keep up intermittently. Splendid inquiry is before the trade for molding machines, sand cutting and handling machinery, but with the exception of one or two cupolas that are wanted, that branch of the trade is quiet in a prospective way. The Allegheny Foundry Co., North Side, Pittsburgh, was a recent purchaser of both wheelbarrows and flasks. The Whiting Corp., Harvey Ill., has sold a cupola to the Pittsburgh Valve & Fittings Co., Barberton, O.; and to the Newman Foundry Co., Kendallville, Ind. The largest cupola inquiry pending is that of the Standard Sanitary Mfg. Co. Baltimore, Md., which has been before the trade for some time past. Molding machine business expected to develop by now has failed in large part to materialize. A few orders for single installations have come through and more are expected within the next few days, including one or two involving four to six machines each. The New York Car Wheel Co., Buffalo, awarded the Herman Pneumatic Machine Co., Zelienople, Pa., one jar rollover machine for the drag and a jar stripping plate machine for the cope to be utilized in car wheel manufacture. The National Foundry Co., Erie, Pa., ordered a rollover machine from the same manufacturer as did the Michigan Steel Casting Co., Detroit. The Floyd-Wells Co., Royersford, Pa., placed an order with the W. W. Sly Mfg. Co., Cleveland, for a waterpolishing mill. Foundry crane installations have been few and far between of late but the McIntosh & Seymour Corp., Auburn, N. Y., recently awarded three 15-ton cranes to the Pawling & Harnischfeger Co., Milwaukee. This crane builder also took an order from the Donovan Wire & Iron Co., Toledo, O., for a 10-ton crane with 60-foot span. Some demand for foundry equipment of various sorts is expected to develop from the Pittsburgh Malleable Iron Co. at an early date since it has awarded Conley & De Mey the general contract for a 95 x 260-foot addition. The Damascus Steel Casting Co., New Brighton, Pa., has just been chartered with a capitalization of $300,000. C. H. Capper, New Brighton, is one of the incorporators and at a later date it is understood some equipment will be bought. The Pangborn Corp., Hagerstown, Md., has received an order from the K. T. B. Foundry, Ltd., Sydney, Australia, for a sand blast and dust arrester.

Cheerful In Some Lines

THE foundry equipment market in the Chicago district has been spotty the past fortnight, some interests reporting inquiry and sales much improved over early September while others state tentative business is fair and actual placements are poor. The Studebaker Corp., has closed for a sand blast and dust arrester with the Pangborn Corp., Hagerstown, Md. The National Engineering Co. has sold a special sand mixer to the Florence Pipe, Foundry & Machine Co., Florence, N. J.; and standard sand mixers to the American Malleables Co., Owosso, Mich., the American Radiator Co., Buffalo, and the Pawling & Harnischfeger Co., Milwaukee. The Whiting Corp., reports the sale of a cupola to the Landis Machine Co., Waynesboro, Pa., and the Brooklyn Foundry Co., Astoria, N. Y.; a 9500-pound bottom-trip steel ladle to the Maynard Electric Steel Castings Co., Milwaukee; a 30 x 60-inch tumbler to the Reliance Foundry Co., Flinger, Wis.; a cupola to the Yonkers Foundry Co., Yonkers, N. Y.; a 3000-pound ladle, helical-geared, to the Connersville Blower Co., Connersville, Ind.; a 3000-pound truck ladle to the Holland Furnace Co., Holland, Mich.; a small cupola to the Vesuvius Plow Co., Vesuvius, Va.; and two 3000-pound bottom-trip ladles to the Crucible Steel Co. of America, at Pittsburgh. The tendency toward the use of steel flasks for large work of light weight, like sanitary ware, is decided. A second large installation of this equipment in the Middle West is under way. The W. W. Sly Mfg. Co., Cleveland has received orders from the Moline Iron Works, Moline, Ill., for core oven equipment, and from the Link-Belt Co., Indianapolis, Ind., for two sand-blast mills.

New England Finds Sales Slow

FOUNDRY equipment dealers have found few buyers throughout New England during the past two weeks. Several foundries which are under construction at the present time offer a potential demand but nothing of importance has yet developed. The heaviest buyer since the first of the month is the Yale & Towne Mfg. Co. of Stamford, Conn.,

which concern has placed orders for several molding machines and for flask equipment against a fairly long list. The balance of the list is expected to be covered in the near future. The Massey Harris Co., Toronto, Canada, has awarded the Pangborn Corp., Hagerstown, Md., an order for sand-blast equipment. A western Massachusetts foundry is in the market for a 10-ton crane. A Springfield, Mass., foundry recently purchased a compressor and other equipment. The new foundry of H. B. Smith Co., at Westfield, Mass., has been delayed due to shortage of labor, but now is going ahead and will require a large number of special molding machines and much other equipment. The W. W. Sly Mfg. Co., Cleveland, has received orders for dust arrester equipment from the Saco-Lowell Shops, Boston, and from the Holmes Foundry Co., Ltd., Sarnia, Ont.

Little Developing in the East

NO MATERIAL improvement has developed in the eastern foundry equipment market. Inquiry is slightly better, but orders, for the most part, are coming through slowly. Included in recent orders is an electric furnace for the plant of the International Nickel Co., at Huntington, W. Va., this business going to the Pittsburgh Electric Furnace Corp., Pittsburgh. The Columbia Machine Works & Malleable Iron Co. Brooklyn, has just closed on 600 tons of steel for a building to replace the portion of its plant badly damaged by fire several weeks ago. It is understood, however, that the major portion of the new structure will be devoted to a machine shop, and that, therefore, little foundry equipment will be required. The Richardson & Boynton Co., Dover, N. J., is inquiring for four electric hoists. The Boynton Furnace Co., Jersey City, N. J., recently noted as contemplating an extension, is reported to have decided to postpone this project until next year. The Frick Co., Waynesboro, Pa., has recently purchased two 5-ton jib cranes from the Whiting Corp. Some sizable business, recently reported as pending still is being figured by two large companies identified with the railroad industry. As a whole, current demand is made up almost entirely of equipment for replacement purposes. However, a seller of molding equipment in this district reports that his plant is still operating on a day and night shift, but this situation appears exceptional among the plants of the great majority of equipment sellers. No immediate changes in prices of foundry equipment are expected.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

The Prime Mfg. Co., Milwaukee, is considering the erection of a brass foundry.

Revised plans are being prepared for the foundry planned for the Canadian Westinghouse Co., Aberdeen Street West, Hamilton, Ont.

The Free Sewing Machine Co., Rockford, Ill., operator of a gray iron foundry was damaged by fire recently with loss of about $75,000.

A foundry and machine shop is to be constructed soon at Kimberton, Pa., by interests of Phoenixville, Spring City and Kimberton.

Approximately $2500 damage was done by fire recently at the Perseverance Iron Foundry, Inc., 822 Latona street, Philadelphia.

Ground has been broken for the plant on South Logan street of the Lindell Drop Forge Co., Lansing, Mich.

A brass and aluminum foundry has been added to the East Dubuque, Ill., plant of the Waller Mfg. Co.

Contract has been awarded by the Lindell Drop Forge Co., Lansing, Mich., for a forging plant, 60x300 feet.

The United States Foil Co. will erect a $10,000, 1-story foundry addition at Thirteenth and Grand avenues, Louisville, Ky.

Abraham Kamberg, Springfield, Mass., has been named receiver of the Palmer Foundry Machine Co., Palmer, Mass.

Hotz Foundry & Mfg. Co., Fremont, O., went into involuntary receivership when Judge Killits appointed Albert V. Baumann Jr., that city, as receiver.

Fire recently damaged the Turner Tanning Machinery Co., Peabody, Mass., operator of a gray iron, aluminum and brass foundry, with a loss of about $1000.

The Roberts Brass Co., Lincoln and Alexander streets, Milwaukee, has been granted a permit to build a $20,000 addition to its foundry and machine shop.

The Hall Foundry & Machine Co., Jacksonville, Texas, was badly damaged by fire recently. The estimated loss of $50,000 was not covered with insurance.

G. S. Burtis, H. B. Morrow and Robert Beaird have purchased the Burr Co., Champaign, Ill., manufacturer of castings and fabricated steel specialties.

The Southern Brake Shoe Works, Inc., Portsmouth, Va., plans a $50,000 plant. It is now operating in the plant of the Southern Brass Works, that city.

Plans are being drawn for a 1-story, 40 x 90-foot foundry for L. Schutte, 650 East Marion street, Lancaster, Pa. The new building will be of brick and steel.

The William J. Collins Foundry Co., Inc., is to be organized by William J. Collins, formerly connected with the Milford Iron Foundry, Milford, Mass.

A 3-story building recently was completed by Phillips & Buttorff Mfg. Co., Nashville, Tenn., manufacturer of stoves, ranges, refrigerators, etc., and operator of a gray iron foundry.

Bellingham Steel & Forge Co., Bellingham, Wash., has been incorporated for $30,000 by Fred W. Neal, B. E. Shellebarger, T. Shellebarger and Dan Erickson.

Saboco Pump Co., 121 Light street, Baltimore, Md., was incorporated for $25,000 by Charles R. Samm, Guy C. Bopst and others to manufacture pumps, tanks, etc.

The Southern Brake Shoe Works is reported to be planning the erection of a modern brake shoe foundry on the Belt Line railroad near Portsmouth, Va.

The North Milwaukee Foundry Co., Thirty-second street and Commerce avenue, North Milwaukee, Wis., operator of a gray iron foundry, is taking bids on a side addition to its plant.

The Universal Oil Burner Co., Ltd., Windsor, Ont., has been incorporated to manufacture oil burners, stoves, furnaces, etc., by Clifford E. Greenan, Donald Stuart and Norman A. McLarty with $40,000 capital stock.

The Oakland Foundry & Furnace Co., Oakland, Cal., will begin production soon of a patented furnace and will operate a general commercial foundry. It will move its plant to its new site on Third street, West Berkeley, Cal. Capacity was increased by 25 per cent when a new core room and foundry were added to the plant of the National Radiator Co., New Castle, Pa. The new addition is 62 x 405 feet.

James B. Clow & Sons, Harrison and Franklin streets, Chicago, operator of gray iron, brass and aluminum foundries, has purchased the plant of the Sullivan Machinery Co., that city.

The idle iron foundry of the late Herbert B. Murlless, Rockville, Conn., of the Hockanum Mills Co., that city, has been leased by Henry Carpenter, Chicoppe Falls, Mass., and will be put into operation soon.

State Pattern & Foundry Co., 12, 160 East Fifty-seventh street, Chicago, has been incorporated for $25,000, by G. B. Kearns, A. E. Ose, H. D. Luker, to manufacture and sell certain battery terminal devices, experimentation, and automobile accessories.

The Oakland Foundry & Furnace Co., Oakland, Cal., will remove its plant to its new site on Third street, West Berkeley, Cal., where it will extend its operations to cover the manufacture of a patented furnace and the operation of a general commercial foundry.

Findlay Bros., Carleton Place, Ont., manufacturer of stoves, furnaces, etc., and operator of a gray iron foundry, plans to manufacture electric stoves and other equipment and is installing an electric annealing oven of 100-horsepower capacity.

French Sand Dryer Co., Keystone, W. Va., organized with Jacob Spector as president and C. S. French as manager, plans the construction of a building to cost $15,000 to be equipped with dressing machines, lathes, etc., for the manufacture of sand dryers.

Construction on the building being erected for the Saco-Lowell Shops, Lowell, Mass., operator of gray iron, brass and aluminum foundries, etc., is nearing completion. A forge shop on the ground also will be ready soon for operation.

The western distributing center of the Stand-

ard Sanitary Mfg. Co., Pittsburgh, operator of gray iron foundries in that city and Brighton, Pa., Louisville, Ky., and Toronto, Ont., will be located in Indianapolis, Ind., following the purchase of a site there.

City Foundry Co., 811 Park avenue, St. Louis, Mo., has a foundry building with a daily output of 50 tons of gray iron castings. The company was incorporated in September for $40,000. Fred W. Priep is president, Henry F. Welsch secretary and treasurer and U. S. Arnold manager.

The buildings and land of the Elyria Machine Co., Elyria, O., have been taken over by the Elyria Foundry Co., that city, subsidiary of the Brown Hoisting Machinery Co., Cleveland. The Elyria Machine Co. was formerly controlled by the Cromwell Steel Co., Lorain, O.

Operations will be continued in the plant of the Christopher & Simpson branch of the Mississippi Valley Structural Steel Co., on Park avenue and Eighth street, St. Louis, recently sold to the City Foundry Co. The Mississippi Valley company purchased the plant for $85,000. It will continue production of gray iron castings under its new ownership.

Theodore Aulman, head of the Eagle Iron Works, 301 East Court street, Des Moines, Iowa, is taking bids on additions to his plant. A $50,000 1 and 2-story, 60 x 140-foot foundry is to be built first. A $20,000 pattern shop will be built later, it is reported. The Eagle works now operates a gray iron foundry, machine shop and pattern shop.

Approximately $200,000 will be spent in making extensions to the plant of the Auto Specialties Mfg. Co., St. Joseph, Mich., manufacturer of malleable iron castings, automobile jacks, shock absorbers, hardware, etc. The new additions include reinforced concrete buildings, consisting of a hard iron cleaning room, 100 x 100 feet; a foundry, 100 x 200 feet; a core room, 50 x 55 feet; a 20-ton melting furnace and three small sheds for core sand, molding sand and sprue with storage compartments.

New Trade Publications

STEEL TRUCK BODY—The McNamara Bros. Co., Baltimore, has issued a folder showing an all-steel body dump truck. A table shows various sizes and the capacities for each.

AUTOMOTIVE SERVICE—The T. R. Almond Mfg. Co., Ashburnham, Mass., is issuing three pamphlets on automotive service equipment, including such items as drill and lathe chucks, micrometer equipment, and gages. All items are illustrated and described separately, with their respective specifications.

CHARGING EQUIPMENT—The General Electric Co., Schenectady, N. Y., has published a 12-page illustrated circular describing charging equipment for vehicle motive power batteries. Photographs and descriptions include motor-generator, switchboard and control units and a switchboard layout is given.

WATER FILTERS—Horizontal pressure type water filters are described in an illustrated 12-page catalog published by the Graver Corp., East Chicago, Ind. The filters are shown by means of photographs and facsimile blueprints, both in separate and battery installations. Equipment such as gages, sight glasses and filter strainers are depicted separately and in assembled installations.

OIL-GAS CORE OVENS—The Northern Machinery Co., Minneapolis, has issued a 4-page circular describing the use of the industrial oil-gas burners which it manufactures. The features of the equipment which the manufacturers emphasize consist of economy of time, space, laobr and material. They claim that core loss in a foundry may be reduced to as low as 1 per cent. Several illustrations are shown in the circular demonstrating the use of these burners.

CARBON DIOXIDE RECORDER—Bulletin No. 117 of the Uehling Instrument Co., Paterson, N. J., illustrates, in diagrammatic form, the principle of operation of carbon dioxide recording and indicating equipment which has no moving parts and employs no chemicals in liquid form. It operates on a principle based on varying gas tension between two orifices. The diagram shows essential parts arranged as a train and includes the features required to obtain suitable sample for flue gas analysis.

COMPRESSOR AND VACUUM PUMPS—A 32-page bulletin has been published by the Pennsylvania Pump & Compressor Co., Easton, Pa., in which air compressors and vacuum pumps manufactured are illustrated and described. The air compressors and vacuum pumps are similar in that they are both of the straight line center crank type and are either power or steam driven. The continuous lubrication system, using the main frame as a basin, is maintained by a force feed and is used for both the air and steam cylinders.

CENTERLESS GRINDER—A 12-page booklet illustrating and describing parts, assemblies and operation of a centerless grinder has been published by the Cincinnati Milling Machine Co., of Cincinnati. The arrangement of the parts is shown by means of a diagram while the operation of the machine is straight cylindrical work and in shoulder grinding is illustrated by photographs. The description of the construction of the machine takes up such items as the spindle, wheel truing devices, work rest, speed control box and pumping system, a photograph of each accompanying the description.

SAND-BLAST EQUIPMENT—A 6-page circular has been published by the Ruemelin Mfg. Co., Minneapolis, describing its sanitary, sand-blast equipment. The equipment listed is suitable for cleaning all sorts of castings requiring 7 to 9-foot tables, and patents of these designs are pending. The advantages claimed for these are cleanliness of operation, economy of labor, and large table capacity. Another feature of the bulletin is the description of a portable sand-blast gun, the suction power of which according to the manufacturer, is sufficiently great to permit its use 40 to 70 feet above the sand supply. Some of the equipment described is intended for use in small foundries and machine shops where the volume of work does not warrant the use of a larger set of equipment.

SINGLE LINE BUCKET—A 36-page illustrated catalog has been published by the Blaw-Knox Co., Pittsburgh, describing the products. The machinery featured in the catalog is the single line bucket manufactured by this company. The manufacturer claims that the omission of the locks, catches or other sliding parts in the model shown is advantageous. These buckets are described with capacities ranging from ¼ cubic yard upward, for handling loose material such as coal, coke, sand, slag and cinders or digging iron ore, broken limestone, scrap or shale. A foundry type of this bucket is included in the catalog. This bucket is designed to operate with a minimum of head room. Single rope cableways also are described and illustrated. The remainder of the catalog is filled with pictures showing the equipment in operation.

THERMIT WELDING—The Metal & Thermit Corp., New York, recently has published a 72-page booklet describing the process of making thermit rail welds. The weld described in the booklet is made by pouring superheated steel obtained by the thermit reactions into a mold surrounding the rail ends at the joint. The material melts all parts of the rail section with which it comes in contact and on cooling solidifies as a whole. The materials used for this mold as well as the preheating apparatus and the crucibles to perform the process of welding are described in the bulletin. Some of the apparatus, including the manufacture of thermit and alumino-thermic mixtures, is covered by patents. The function of the rail weld is to eliminate rail joints and the manufacturers advise its use in place of the bolted joint.

INDUCTION MOTORS—A 14-page booklet has been published by the Reliance Electric & Engineering Co., Cleveland, describing model of induction motors for two and three phase alternating current circuits. The manufacturer calls attention to the insulation of the stator windings, bearings, rotor construction, and high overload torque capacity as features in the construction of the alternating current motors. The stator punchings of special electrical sheets are assembled with the end flanges under 10 tons pressure and riveted. The slots in the stator punchings are semienclosed. As a result the manufacturers claim that the winding is easier and the overload torque capacity is increased. The windings are varnished to increase their resistance of dirt and acid. The auto-transformer necessary for motors with a rated capacity of 7½ horsepower is also illustrated.

HEAVY MACHINERY—An elaborately executed bulletin of 64 pages most of which are filled with illustrations has been prepared by the Mesta Machine Co., Pittsburgh. Views of the plant and its products are given. Some of the products listed are gas and steam engines for blast furnaces, rolling mills and power plants, barometric condensers and vacuum pumps, rolling mill machinery, forgings, castings, patented pickling machines and miscellaneous machinery, including cut and machine molded iron and steel gears, flexible couplings, accumulators, air compressors, large power presses, rope drives, and hydraulic and steam hydraulic forging and bending presses. The general type of machinery illustrated is that of which heavy castings are a part. A specialty is made of rolling mill machinery, of which the following types are listed; bar, blooming, continuous, plate, rail, sheet, slabbing, strip, structural, tin plate, tire, tube, universal, and wheel mills.

FINISHING EQUIPMENT—Frederic B. Stevens, Inc., Detroit, has just completed a 241-page catalog with an index, describing a complete line of foundry equipment, some of which it manufactures and other for which it acts as agent. Its manufactured products include buffing compositions, plater's supplies, foundry facings and foundry supplies. The buffing lathes which it manufactures have a unit spindle assembly with bearing housings, pulleys, etc., mounted, which may be removed by removing the two nuts holding the bearing housing clamp. Dust-collectors, exhaust fans, and grinders of various classes capable of doing grinding difficut to reach are described in the catalog. Electro-plating apparatus, including motor-generators, self-emptying plating barrels, a patented moving cathode plating apparatus, electrical instruments and chemical supplies conclude the types of equipment described in the catalog. A feature of the publication is an illustrated narrative of abrasive materials, their origin and use.